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Tabor Indicator with Houghtaling Reducing Motion.

Our readers who have been following the recent discussion in these columns of indicator-reducing motions and their proper design will be interested in the accompanying illustration of the Houghtaling reducing device, which forms a part of the indicator; and, when the latter is in place upon the engine, is also itself ready for use without further rigging up except such as is needed for attaching the cord to the crosshead.

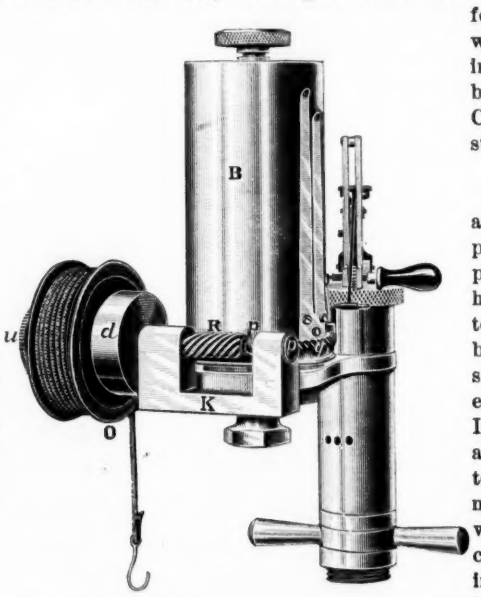
The device consists essentially of a supporting base piece K, on which are standards forming bearings for a worm shaft R; the bearing at P being a pivot which takes the end thrust and reduces the friction to the minimum. The flanged pulley O receives the cord and drives the worm shaft through the medium of the spring case d, and outside the pulley O is a knurled button u, which is a clutch for connecting and disconnecting the pulley O from the shaft, and thus stopping or starting the paper drum B without touching the cord.

The retracting spring in the paper drum rotates the drum backwards as usual, and takes care of all lost motion in the mechanism between the drum and spring case d, in which there is a plain spiral spring which takes up all slack of the cord and rotates the pulley O and shaft back on the return stroke.

The flanged pulley O runs freely upon the worm spindle, and may run uninterruptedly during a test, or while a series of diagrams are being taken, the starting and stopping of the paper drum being effected solely by the clutch u, or by the knurled thumb piece surmounting the drum. This thumb piece is provided with a projecting pin which engages with a similar pin on the drum, and is used by the operator for moving the drum slightly forward when taking a diagram, to prevent it from striking against its stop on the return motion.

The simplicity and convenience of the device will be perceived from a description of the method of using it, which is given by the makers as follows:

First select a pulley whose circumference is from ¼ to ½ the length of the engine stroke, so as to allow of its being revolved four or five times with each stroke of the engine. [Pulleys 1 inch, 2 inches and 3½ inches diameter are furnished.] In placing this pulley on the worm shaft R, after removing the clutch and its collar, care should be taken to have it set on the small projecting pin on the cover of the spring case d; then replace the clutch collar and clutch, pushing the collar onto the shaft, as far as it will go, and holding it in place by the set screw. Next, place the indicator in position and run out the loose end of the cord in a direct line with the pulley O to the point on the engine to which it is to be connected; then bring the crosshead of the engine to the extreme limit of its backward motion and attach the loose end of the cord, being particular to have sufficient cord wound on the pulley to meet the extreme limit of the forward travel of the crosshead, with one or two turns of the cord left on the pulley, unwound. When the crosshead, with cord connected, is at its extreme *forward* travel there should be just sufficient tension on the spring inclosed in spring case d to take up all slack of the cord when running, without overtaxing the spring.



TABOR INDICATOR WITH HOUGHTALING REDUCING MOTION.

If, upon starting the engine, the cord should at first run unevenly on the pulley O, turn the indicator slightly until a perfect and uniform winding of the cord is obtained, which can always easily be secured. When pulley O is running, motion to the paper drum B is obtained by pushing in the thumb piece u, to which the clutch pin is secured.

When ready to take diagrams, after placing the paper on the drum B, it is first necessary to advance the drum away from its stop fully ¼ inch, which can be done by turning with one hand the knurled top thumb piece. While holding the drum in this position, with the other hand push in gently the thumb piece u to start the paper drum in motion.

The motion of the paper drum B can at any time be instantly stopped for removing the diagrams taken and renewing the paper by withdrawing the clutch thumb piece u, or by turning the top thumb piece, the latter method being preferable. The stopping of the paper drum will not have any effect on the motion of the pulley o, which will continue to revolve independently while the engine is in motion. This motion now forms a part of the well-known Tabor indicator, and is made by the Ashcroft Mfg. Co., 111 Liberty street, New York.

It is said that an alloy consisting of 95 parts of tin and 5 parts of copper adheres so tenaciously to glass that it may be employed as a solder to join the ends of glass tubes. It is obtained by adding the copper to the tin previously melted, agitating with a wooden stirrer, casting or granulating, and then remelting. It melts at about 360° C. By adding from a half to one per cent. of lead or zinc, the alloy may be rendered either softer or harder, or more or less easily fusible. It may also be used for silvering metals or metallic thread.

An esteemed contemporary makes the startling announcement that there is a great deal of trouble from vibration of steam pipes attached to engines; that the trouble is worst with slow-running engines, and it "not infrequently proves to be impossible to anchor the pipes in a manner to entirely overcome movement." Nevertheless, there is, happily, a remedy, and that is to place a steam reservoir near the engine, and draw steam from that. We do not expect to find many of these reservoirs in use.

Universal Grinder for Heavy Work.

In our issue of August 3, 1893, we illustrated an improved universal grinding machine made by Landis Bros., of Waynesboro, Pa., and in issue of August 17th we illustrated the method of doing many varieties of work upon the machine.

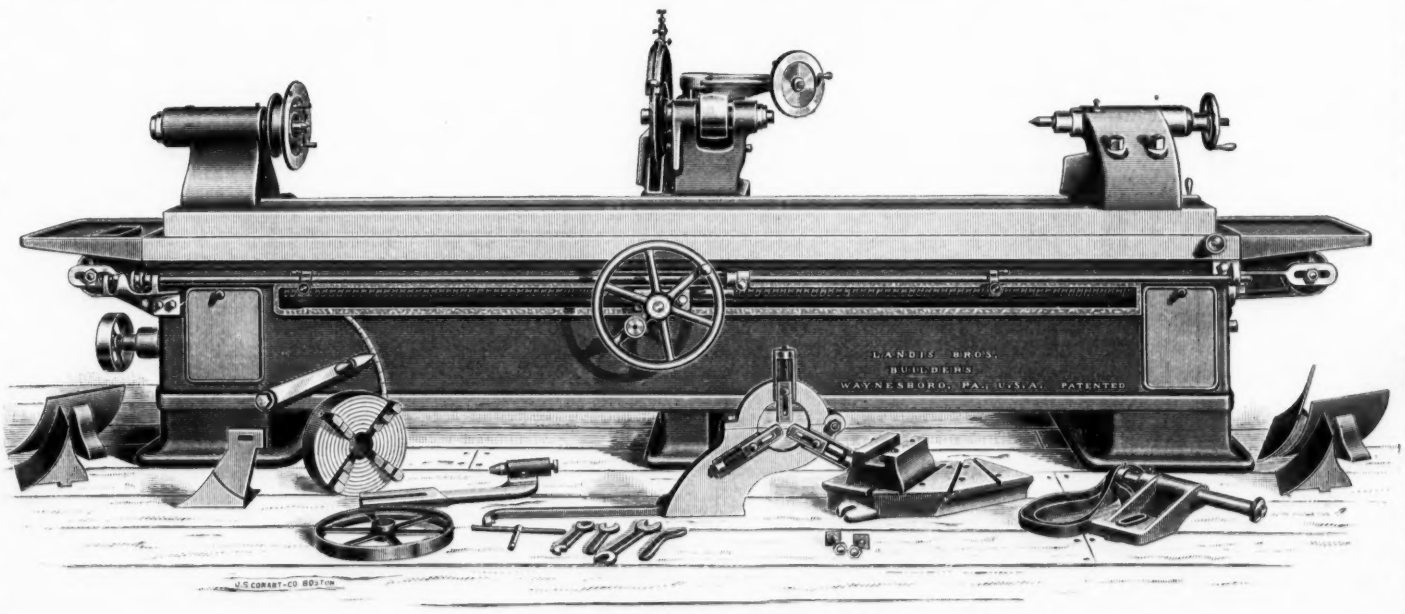
The illustration upon this page is of a larger and heavier machine, intended for heavier work, but retaining the distinctive features of the former construction except where considerations of convenience of handling as applied to the larger machine made modifications advisable.

The flexible covering for the otherwise exposed sliding surfaces is arranged somewhat differently and keeps the surfaces covered in all positions of the carriage.

The carriage is traversed by a screw, and the hand-wheel for moving it by hand moves along the bed with the carriage thus keeping always at the hand of the operator.

The automatic reverse of the feed motion is by means of a rod on which are two clamping collars provided with screws which are struck by the moving carriage; the adjustment of these screws giving the fine adjustment of carriage traverse. The lever by which the feed is started and stopped also travels with the carriage, and thus all necessary means for handling the machine are conveniently placed.

The foot-stock spindle is also arranged somewhat differently, as in this machine it is moved to or from the work by a hand-wheel and screw, as in the lathe, but a spring is interposed and arranged in such a way that this spring can allow for expansion and contraction of the work while upon the centers, or the tail center may be held rigidly, as desired.



UNIVERSAL GRINDER.

The rate of carriage traverse is altered by means of the lever seen at the left hand end of the bed, this lever serving to alter the relative positions of friction wheels inside the bed, and giving a great range of speed without stopping to make changes, as in the smaller machine referred to above.

The fixtures which accompany the machine are the same as for the smaller one, except that there is no special chuck or rests for grinding cutters.

This machine will grind work up to 20 inches diameter, and is built with two lengths of bed to take between centers 63 inches and 99 inches, and weighing about 8,000 pounds and 9,800 pounds respectively.

They are also made plain—for straight and taper shaft grinding only, or for straight work only and special provision is made for the use of water without "slopping" over the machine.

Theory of Steam Engine Governors—V.

BY J. BEGTRUP.

Near the end of my article of March 1st, I gave the following formula:

$$\frac{W D^3 N}{P S} \times \sqrt{\frac{a f q^3}{l}} > 4{,}524{,}000,$$

which is the main part of the theory of governors in a nutshell, as it were.

I have also mentioned some of the most important applications of the formula, and explained how the quantity a is computed for a gravity governor. It is obtained in precisely the same manner for a shaft governor, but I am not certain that I have made this perfectly clear, and shall, therefore, here, by an example, show how it is done. Fig. 26 represents a shaft governor, with an eccentric which moves transversely to the shaft, so as to vary the eccentricity; rods, rocker arm and valve are also indicated in the figure. Suppose we move one of the balls from the inner to the outer stop; this will cause a movement of the eccentric, rods and valve, but the amount of motion of the valve and valve gear corresponding to such motion of the ball will depend on the position of the governor. Let the mean motion of rods, upper part of rocker arm and valve be one inch, and their collective weight 100 pounds. Let each ball weigh 20 pounds, and move 3 inches, and let the eccentric and strap weigh 50 pounds and move 2 inches; then, if the center of one of the balls be the representative point, we have for one half of the system

$$a = \frac{12\,g.\,3^2}{20\,3^2 + \frac{1}{2}.\,50.2^2 + \frac{1}{2}.\,100\,1^2} = 10.5.$$

It is not necessary to be very exact in such calculations; it would be a mere waste of time, but a faculty for estimating results roughly is desirable, as thereby "big blunders" are avoided. It will easily be seen that something is gained by making the balls heavier for the centrifugal force (f) is directly proportional to the weight of the ball, while this weight is only a part of the divisor of a. But there is little gained by heavy balls when the valve gear is light, and it is better to avoid the great strain on the journals. To obtain the quickest motion in the governor under consideration, we should have

$$l_1 = \sqrt{\frac{\frac{1}{2}.\,50\,2^2 + \frac{1}{2}.\,100.1^2}{20}} = 2\tfrac{5}{8} \text{ inches.}$$

where l_1 = actual motion of the ball between stops, for this value of l_1 will make $\frac{a}{l}$ a maximum. In the present case $l = l_1$, but I have used the symbol l, for the actual motion of the ball, in order to make the demonstration more general. From this example it will be seen that the movement of the ball should be comparatively short, a fact which I think is recognized by engine designers.

A few words about testing governors may here be acceptable to the practical reader. Governors are usually tested in the erecting shop; this is a rather hard test for the ordinary centrifugal governor if a pulley or fly-wheel has to be left off to give place for the brake pulley, for a multiplicity of brake pulleys would be a luxury, and if we use a pulley of medium size it will not do as a fly-wheel for large engines. A brake pulley 48 inches in diameter and 9 inches face is sufficient for engines up to 200 horse-power, and perhaps for larger ones, if sufficient water is run into the rim. It should be remembered that a certain amount of heat must be carried off for each horse power developed, and if the brake pulley shall only be heated to a certain temperature we must pass a certain amount of water over the cooling surface of the pulley in unit of time; there must, therefore, be ample opening in the pipe which scoops the water out of the rim, and the inlet pipe must be able to supply all the water needed. The advantage of the larger pulley lies in the larger cooling surface.

Fig. 27 represents a brake and pulley; the arms A should be hinged so as to avoid undue strains, and that they may be easily removed; the upper arm should be very stiff, and there should be an abundance of strength in the arms and hinges, for a breaking of these parts would probably be fatal to the man at the brake wheel, while a breaking of the band or stripping of the screw thread would probably not hurt him. An ordinary platform scale will do for the weighing of the load, and if distance A = 5 feet 3 inches, we have one thousand divided by revolutions per minute = number of pounds on the scale per horse-power after the unbalanced weight of the brake has been subtracted.

To test a governor we should use a first-class tachometer. When the engine is started up the speed will go considerably above mean speed, how much depends on the design of the governor and the initial deflection of the spring, if it be a spring governor. If the initial deflection of the spring is not too great and the speed runs up more than usually and immediately recedes, it is a sure sign that there is too tight a fit in some place or something else prevents the governor from working freely. There is no place on an engine where a snug or easy fit is more necessary than in the governor, and the machinist who does not know that won't do on governors. If the speed runs up too high we may as well take the springs right off, for we shall not know anything about the trouble before this is done; then it may be necessary to take everything apart and try the journals separately.

If the speed slowly increases after the engine is up to speed and does not recede, then tighten the brake slightly, and if this causes an immediate and sudden diminution in speed it is sufficient evidence that the valve admits more steam than required when the engine is running light and the flow of steam is beyond the control of the governor.

After the workmanship, valve setting, etc., is all as it should be, we are ready to test the governor. If it is a spring governor and the engine is racing, we must shorten the springs or lighten the balls, so as to obtain the proper amount of initial deflection, and the required speed can be obtained by adding to or subtracting from the weight of the balls or by loosening or tightening the springs. Violent racing cannot take place when the engine is running light, for as the balls then are near the outer buffers the oscillation will necessarily be confined within narrow limits; this will also be the case when the engine is fully loaded. Under these circumstances there will probably be enough friction in the governor to keep the oscillation within its proper limits, for the friction needed is proportional to the amplitude of the oscillation.

We must, therefore, put the governor to a more severe test by adjusting the load so that the position of equilibrium of the ball will be a middle position between the inner and outer stop and then cause the governor weights to perform violent oscillations. After the tension of the brake has been adjusted so that the engine will be about half loaded, bring a long plank under the wheel and weigh it down, so as to throw the full load on the engine; then, by suddenly releasing the plank, the governor will be set into violent oscillation and the fluctuation in speed will be clearly shown by the tachometer.

The number of large oscillations can also be plainly counted by observing the exhaust, for every strong puff indicates a complete oscillation or a double motion from the inner toward the outer stop and back again, but the smaller oscillations cannot be detected.

If this operation should set the governor racing there is a strong probability that more friction is needed. A temporary device for increasing the friction can always be applied, and if that stops the racing it suggests the necessity of a pump brake. A further reduction of the initial deflection of the springs will give increased stability, but it will be of little consequence if there is a lack of friction, and it may increase the variation in speed beyond admissible limits. If we put another fly-wheel or pulley on the engine or connect it with revolving machinery which has the same effect less friction will be required, and the pump brake may then become superfluous.

The action of an automatic cut-off governor connected with an eccentric of variable

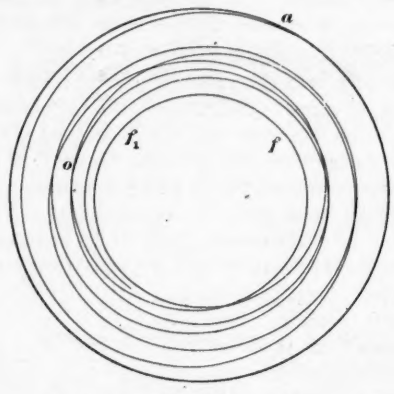


Fig.29

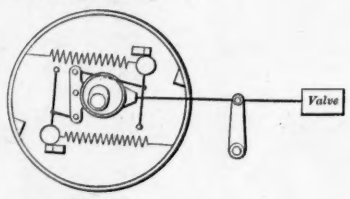


Fig.26

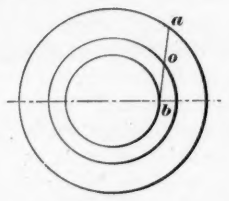


Fig.30

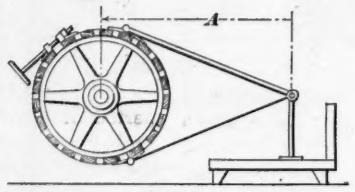


Fig.27

Fig.31

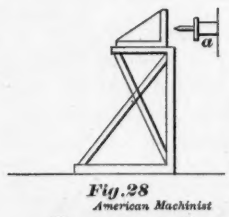


Fig.28

American Machinist

THEORY OF STEAM ENGINE GOVERNORS.

throw or eccentricity can be shown by a simple apparatus if the eccentric is on the outside of the governor wheel. In Fig. 28a is the eccentric in which is inserted a pointed steel pin; on the stand in front of it is a light tablet set vertically and adapted to slide between guides on top of the stand and a piece of tin is fastened to the face of the tablet; when this is brought into contact with the steel point there will be described a circle on it, and the diameter of this circle will correspond to the throw of the eccentric. If the governor is not in steady equilibrium there will appear circles of varying diameter, and thus any fault in the regulation may be detected. If any load is suddenly thrown on or off the consequent oscillation will become apparent by a number of spirals crossing each other, and the initial and final position of the eccentric can be shown by holding the tablet against the steel point long enough to allow it to cut two distinct circles which then represent positions of equilibrium before and after a change of load.

The time of the oscillation can be ascertained by counting the coils of the spiral between two extreme positions of the eccentric and dividing by the number of revolutions per second.

This can also be obtained by calculation and the spirals become interesting as an ocular demonstration of the correctness of the calculation.

Fig. 29 is a reproduction of a spiral line of oscillation obtained as here described. The outer circle represents the position of equilibrium when the engine is heavily loaded, and the inner circle through o represents the position of equilibrium when about half loaded. Spirals representing smaller oscillations are not shown because they make it difficult to discern the larger oscillations. The motion commences at a, and the point where the eccentric first passes its final position of equilibrium is denoted by o. The intersection of the circle and spiral is clearly defined, for as the motion has here obtained its greatest velocity the obliquity of the spiral is greatest at that point. When the oscillations become smaller the curves become partly circles or approximately so, as, for instance, f to f_1, the circular parts representing periods of rest, or a very slow motion caused by friction and the action of reciprocating parts at the end of each half oscillation, and the smallest oscillations appear as circles too close together to be discerned. To find the exact time of a free oscillation we must subtract the circular parts of the curve. If we suddenly throw on or off all the load which the engine can carry there will be no free oscillation, for the balls will then strike the buffers. By such experiment we may determine the relative quickness of action of different governors, if all other things are equal, but it does not give any absolute idea of the instantaneous variation in speed, for if we, for instance, increase the moment of inertia of the fly-wheel we shall have a slower action, but less instantaneous variation in speed, and if we increase the steam pressure, we shall have a quicker action, but more instantaneous variation in speed. "Quickness of action" is represented by the time of one whole or half oscillation plus periods of rest; if we take it in any other sense it will be an expression without any definite meaning. An example will make this clear. If we decrease the initial deflection of the spring without changing the mean speed of the governor we shall obtain a quicker action, and consequently less instantaneous variation in speed; but if we only consider the time of motion of the ball from one position of equilibrium to another, disregarding the last part of the half oscillation such time would be very nearly equal for any initial deflection of the spring; but the last part of the motion after passing the position of equilibrium will be considerably shortened by a diminished initial deflection of the spring. The whole time of one half oscillation would therefore in that case be shorter, and the instantaneous variation in speed correspondingly less. It should be remembered that while the ball moves from one extreme position to another the speed is increasing, and while it moves in the opposite direction the speed is decreasing. We can, therefore, not by observing the time of one part of a half oscillation, draw any conclusion or inference as to the instantaneous variation in speed, and if we, on the strength of such observation, should make the statement that the quickness of action is independent of the degree of stability of the governor, it would not be true in any general sense. If we should shorten the spring so as to obtain considerable less initial deflection, it would have the effect of reducing the speed considerably under full load, and if we then should suddenly throw off some load the speed would immediately increase and approach toward mean speed, and there would probably be a further increase of speed above mean speed, and it will readily be seen that the deviation from mean speed would be greater if the speed had not in the first place been considerably below mean speed, and if we observe the instantaneous variation as shown by a tachometer we shall find this to be the case generally, and we shall also find that having changed the spring as here described the governor will "recover" in less time than it would with the longer spring. The mean speed must be supposed to be the correct speed, and the less the speed varies from mean speed the better the regulation. I think the instantaneous variation in speed of a governor

can best be ascertained by connecting it with a sensitive tachometer; it may not show the variation correctly if the governor is very quick acting, but it is probably the best instrument for the purpose which can be had at the present time, and it is certainly more reliable than conclusions drawn from the time of oscillation, as shown by the spirals, for the tachometer will at least give the extent of the instantaneous variation in speed relatively correct.

The diagram in Fig. 29 is from an "inertia governor," and should not be taken as representing the action of a centrifugal governor, but any governor without exception will, of course, show similar oscillations if the load is suddenly released or applied; if the diagram does not show such oscillations the experiment is incomplete.

It is not apparent from the figure that the oscillation extends equally on both sides of the position of equilibrium, but that this is very nearly the case will appear by a consideration of the motion of the eccentric.

In Fig. 30 the eccentric moves from a to b, and o is the position of equilibrium. A is the center of rotation and the circles through a, o and b will explain the matter without further comment. It should also be noticed that the oscillation is rapidly decreasing, and the motion after passing the position of equilibrium will, therefore, be considerably shorter than the immediately preceding motion toward the position of equilibrium.

The engine made 240 revolutions per minute, and the time from releasing the plank to the first crossing of the position of equilibrium is, according to the diagram, less than $\frac{1}{8}$ second and the time of one-half free oscillation is apparently about $\frac{1}{7}$ second, which is very nearly the time obtained by calculation. It should be noticed that the governor was provided with a pump brake which slightly increased the time of the free oscillation. It is obvious that the brake wheel cannot be operated sufficiently quick to obtain a free oscillation, for if it only took a second to release the brake it would amount to the same as a gradually decreasing load and there would be no free oscillation.

All my calculations are based on the limiting condition of stability. This is very nearly the existing condition, for governors are usually so designed and adjusted that the smallest variation in speed consistent with stability is obtained; under such condition the time of one-half free oscillation will be $8.5\,\pi\sqrt{\frac{l}{a\,q\,f}}$ seconds, nearly.

Where l = projected motion of the representative point,

q = corresponding variation in speed expressed in per cent. of mean speed,

a = acceleration of the representative point in the projected direction of motion by an unbalanced force of one pound,

f = mean centrifugal force in the projected direction of motion.

In ordinary governors q varies from 3 to 8, this being very nearly the value at limit of stability. If we—for experimental purposes—should increase q very much, the formula would not give the time accurately unless we at the same time made other changes in the governor or reduced the fly-wheel so as to obtain the same degree of stability as before. The time of the oscillation can in any case be obtained very accurately by calculation, but it would not be of much practical value.

We may test the stability of a governor by taking indicator cards, but such cards should not be taken before the cylinder is heated to the proper temperature, for otherwise we may obtain a series of expansion and compression lines for which the governor is not responsible, and after having taken cards with full load we should not take any friction cards or light cards before the engine has run long enough to obtain the corresponding temperature, for while a temporarily superheated cylinder will give fancy friction cards, it will not show the working of the governor to any advantage.

The intermittent action of the steam in an automatic cut-off engine has the effect of lessening the efficiency of the governor. Suppose a small displacement of the governor weights takes place directly after the steam is cut off, then this will have no effect whatever on the speed of the engine before the next cut-off, or after one-half revolution of the fly-wheel, provided the compression is constant, but a small displacement directly before the cut off will have an immediate effect on the speed of the engine; the mean length of time between cause and effect will, therefore, be the time of one quarter revolution of the fly wheel. For engines with variable compression this period will be shorter, for the speed is also to some extent regulated by varying the compression. If this was as effective as variation of the point of cut-off, the mean period between cause and effect would only be $\frac{1}{4}$ of a revolution for such engines, but as the compression is not so effective as the cut-off, it would probably be more nearly correct to assume a mean period of $\frac{1}{3}$ of a revolution.

In Fig. 31 let the ball move from a to b, and let the boundary line of force y_1 be as shown in the figure, if the regulation is effected by throttling; the other curve shown may then represent force y_1 when the regulation is effected by an automatic cut off valve; as in the latter case there is less acceleration during the first part of the motion, it follows that the period of oscillation would be longer, and, therefore, area y_1 greater than in the former case. We should consequently have less stability, and to obtain the same close regulation as could be obtained by throttling, we must make the fly-wheel heavier than would be necessary if it was a throttling engine having the same governor and all other things equal.

Two automatic cut-off engines having a common crank shaft and cranks at right angles will have twice as many periods of admission as a single engine in a given time, and the governor would, therefore, have a more perfect control over the speed of the two combined engines, and we may, therefore, on such engines, use a lighter fly-wheel than on a single engine of the same power. The effect of the intermittent action of the steam in automatic cut-off engines becomes greater when the period of oscillation of the governor becomes shorter, and the gain by reducing the time of oscillation for such engines would, therefore, not be so great as it might appear from the formula for stability. The quickness of action of governors for such engines should, therefore, not exceed certain limits depending on the speed of the engine. In a high speed engine, where there are a number of admissions in unit of time, a very quick action is desirable, while in slow speed engines a somewhat slower action will give better results. In compound engines there is always a quantity of steam stored in the receiver and low-pressure steam chest, and when the cut-off in the high-pressure cylinder is changed by the governor, there will be an excess or deficiency of pressure in the stored steam, and the full effect of a change of the cut off in the high-pressure cylinder will first then be felt when the pressure in the intermediate space has been correspondingly reduced or increased. This circumstance will have the same effect on the regulation as has the intermittent action of the steam, and it becomes consequently somewhat difficult to obtain a perfect regulation of compound engines. Extra heavy fly-wheels are very desirable on such engines, for they increase the stability by reducing the magnitude of force y_1, and at the same time they increase the period of oscillation, thereby making the intermittent action of the steam and the action of the receiver of less consequence.

The reciprocating motion of the valve and valve gear may in some automatic cut-off engines have a tendency to increase the free oscillation of the governor weights, but this tendency is probably of much less consequence than commonly supposed. The impulses of such reciprocating parts are of the same nature as those of the main reciprocating parts of the engine which have been so thoroughly discussed by other writers. The impulse or disturbing force reaches its maximum when the valve is at the end of its travel, and at that point it becomes equal to the centrifugal force of the collective reciprocating parts if attached directly to and revolving with the eccentric, provided the motion of such parts is equal to the throw of the eccentric, and at mid-stroke the force becomes evanescent. Such impulse is therefore exerted in two opposite directions relatively to the engine, but is always in the same direction relatively to the governor, because the governor is revolving or, more correctly, the period of the disturbing force is repeated twice during each revolution of the governor, and such force will therefore have a centrifugal effect as if a weight equal to half of the reciprocating parts was attached directly to the eccentric. If the force is of sufficient magnitude to produce a motion of the governor weights it will be an oscillatory motion, and if the oscillation is of the same period as the force it will have no disturbing effect on the speed of the engine, for it will in that case not vary the cut-off, but it may give trouble by increasing the free oscillation of the governor weights, although this is not apparent from experiments I have made, for I have often greatly increased the weight of the reciprocating parts on governors with variable throw without observing any other effect than that the initial deflection of the spring must be made correspondingly less, and that it will increase the speed of the engine.* The effect of a permanent disturbing force depends to a great extent on the period of the force, and the period of the free oscillation of the governor weights. The period of the disturbing force due to the inertia of valve and valve gear in an engine making 240 revolutions per minute, or 4 revolutions per second, is one eighth of a second, while the period of an entire free oscillation would probably never be less than one second; the period of the free oscillation is therefore at least eight times as long as the period of the disturbing force, and under such circumstances the influence of the disturbing force will never be of great consequence. The greater the magnitude of the disturbing force is compared with force y of the free oscillation the greater will the disturbing effect be; the disturbing force may therefore cause a state of instability by magnifying the smaller oscillations, but in that case this force will, also, in combination with friction, produce an intermittent motion which has the effect of greatly increasing the stability. The influence of disturbing forces, friction, etc., was discussed by me in an article in the AMERICAN MACHINIST of October 9, 1890, to which I would refer the reader who may wish to study or investigate this matter, and I am very glad to be able to state here that the correctness of my conclusions at that time has since to a great extent been verified by my personal experience and observations, and that every new experiment and observation has become an additional proof of the correctness of my reasoning.

There may in some shaft governors be a disturbing force due to unbalanced gravity of greater consequence than the inertia of the valve and valve gear, for as the governor revolves the direction of gravity relatively to the governor weights will only change once during each revolution. The period of unbalanced gravity is therefore equal to the period of one revolution; for instance, in a governor making 240 revolutions per minute the period of unbalanced gravity is one quarter of a second or twice as long as the period of the impulses due to reciprocating parts, and if we assume the effect of a disturbing force to be proportional to the square of its period we should have unbalanced gravity at least four times as effective as a disturbing force of equal magnitude due to the inertia of reciprocating parts.

* See October 19th issue.

Unless there be two valve stems extending through the steam chest in opposite directions there will be an unbalanced pressure on the eccentric due to unbalanced steam pressure on the valve stem, and this does not in effect differ from unbalanced gravity, except that it may act horizontally as well as vertically; its period is like the period of gravity equal to the period of revolution of the governor. Friction of the valve and valve gear may have a disturbing effect on some shaft governors. The resistance which such friction offers to the revolving motion of the eccentric will have a tendency to push it back, and it will consequently increase the speed of the engine. If the valve by unequal expansion, warping or cutting should get very tight there would be a considerable increase of the speed, and if the friction varies on account of varying steam pressure, or for any other reason, the speed of the engine will vary accordingly. It is obvious that such variation in speed will be inversely proportional to the centrifugal force of the governor weights multiplied by their radial motion, and it may therefore in some cases be advisable to make these weights very heavy. The period of the disturbing force due to friction of the valve is repeated twice during each revolution, and such force can therefore not affect the stability of the governor to any great extent, but it will sometimes increase the stability for reasons which were explained in my article of October 9, 1890. The effect of valve friction can easily be shown by bringing a wooden stick to bear against the valve stem.

The theory of disturbing forces and forced oscillations is still in its infancy, and here is a field for the penetrating mind and creative power of a great mathematician.

The Eight hour Day in England.

The subject of the eight-hour day is being very much discussed at present in England, some recent tests and careful comparisons having shown that men will do practically the same amount of work working 48 hours a week as if working 56 hours. *The Engineer*, which certainly cannot be accused of being biased by excessive sympathy or feeling for workmen in the matter, thus sums the results of the experiments and discussion so far:

THE FORTY EIGHT HOURS' WEEK AND OVERTIME.

"The available evidence adduced in our last impression goes to prove that whether men are putting in a 48 hours or a 53 hours week, they do the same amount of work. This does not apply individually, of course, to all men, but it is comprehensively true of the men as a body, and from the employers' point of view in all establishments sufficiently large to be worth considering. We need not go over ground already well trodden to illustrate this point. If the information is true, not only of particular works but of entire districts, then it is clear that the masters have everything to gain and nothing to lose by the adoption of the new system. But it is all the same very curious that the truth has not been discovered before. What have works' managers and foremen, to say nothing about heads of firms, been about all these years? How is it that they should use their tools and increase all the charges in a way proper to a 53-hours' week, while all the time they would have turned over the same capital and put out the same amount of work in a week five hours shorter? It is the difficulty of finding any satisfactory reply to this question that casts a doubt on the success of the whole experiment.

"On the other hand, however, it may be taken for granted that a great deal takes place in all works which is either not seen or not rated at its true value. A remarkable instance of this is to be found in the relation of piece workers to the 48-hours' week. In theory, men on piece-work turn out as much and earn as high wages as they possibly can. In other words, a man paid

by the piece will in each hour accomplish all that is possible in the time. To cut five hours' work off his week must ostensibly mean, under the circumstances, a reduction of over 9 per cent. in his weekly earnings, yet we are told that in practice this is not the case. We cannot do better, in handling this subject, than quote Mr. Mather's report, because it happens to be the only precise statement available. It is not as full as it might be, but it is the best of its kind for statistical purposes, such as it is. 'It was at the outset,' says Mr. Mather, 'assumed that men on piece-work were already doing their best, and if their period of work were shortened, their earnings would be diminished in a corresponding degree. This anticipation has not been realized, for although there is a falling off in the percentage earned by piece workers over and above what they would have received as day wages, it is slight in comparison with the reduction in the time, and particularly so in the later portion of the year. In order to judge better of the working out of the system as regards piece-work, the year has been divided into three parts of approximately equal lengths. In the first period the surplus over day-work rates was 1.76 per cent less than the standard piece-work wages; in the second period 1.58 per cent. less than the standard piece-work wages; in the third period 0.78 per cent. less than the standard piece-work wages; the average for the 12 months coming out 1.41 per cent. less than the standard. These figures show that as the year advanced there was a steady adaptation to the altered conditions, and it is reasonable to expect that the small difference remaining at the end of the year will soon disappear. It must also be noted that in no single instance during the year were piece-work rates advanced. In fact, some reductions were made—in a few special cases where the rates were admittedly too high. Had these few changes not been made the difference between the two periods would have been 0.5 per cent. only, instead of 1.41 per cent., a difference which is not at all unusual between two years, as slight fluctuations in piece-work earnings have occurred from one year to another under the old system.'

"Mr. Mather does not attempt to give any particular explanation of these facts. He does not try to supply any reason why the men have still turned out the same amount of work as before. All through his report we have the same general idea. There has been no diminution of work anywhere, because the men were better able to earn wages, and when this comes to be analyzed it seems all to have resulted from the men breakfasting before they went to the works. We are not sure that every one will accept this explanation as wholly contenting; certain people will even maintain that the all-round success of the movement has been brought about by the officials of the Amalgamated Engineers' Union. Be this as it may, we are fortunately in a position to extend our view, and, leaving Messrs. Mather and Platt and the Salford Iron Works for the moment, consider what is taking place in government workshops.

In another page we give the regulations now obtaining in Woolwich. We understand that so far the piece-work hands have not earned less wages under the new than the old system. The experience is the same at Woolwich as at the Salford Iron Works, but at Woolwich a custom sprang up years ago of counting piece-work as always equivalent to one-third more than day-work. That is to say, men and boys on the piece could earn one-third in excess of day rates, and no more. The result, of course, was that the men earned their extra one-third, and only that. It seems that this is about one-third less than the men and boys can really earn, and, this being the case, it is not remarkable that removing the restrictions on output has quite satisfactorily compensated for the shortening of the week. The restriction on output operated for evil in another way. It induced—very naturally—unpunctuality in the foremen as well as the hands. There was nothing to be gained by keeping time, and so time was not kept. At Woolwich, as at Salford and Sunderland, the 48-hours' week means better discipline, punctuality, and what would be called in the United States more driving. . ."

Improved Trestle.

An Improved Trestle.

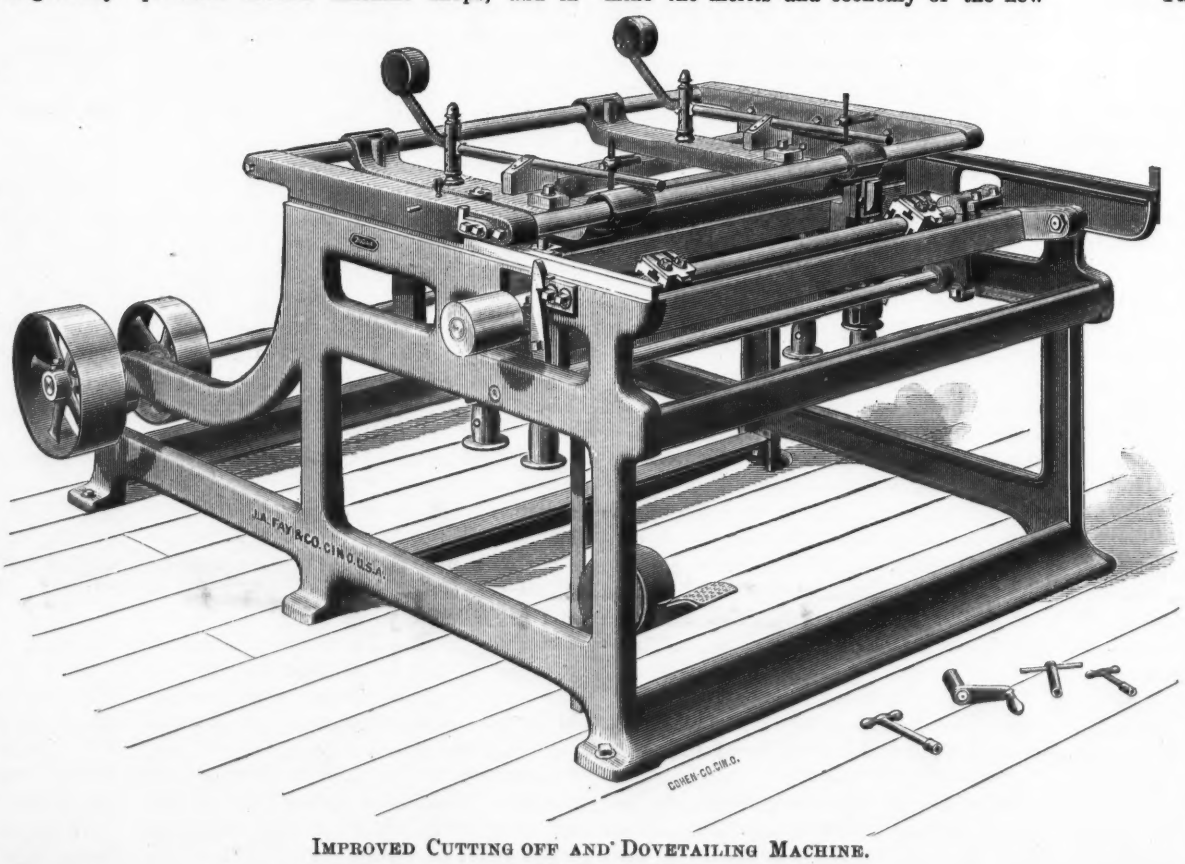
The question of trestles is of some importance around machine shops, and in other places as well, and we illustrate herewith a machinist's solution of the question by which he provides a single pair of trestles that readily take the place of from two to six pairs of different heights, besides being so adjustable as to be exactly the right height, instead of "pretty near it," or requiring the use of blocking, splicing or sawing off legs, etc.

The carpenter's trestle is adjustable from 24 inches to 46 inches high, and the contractor's from 6 feet to 11 feet 6 inches, and they can be readily and securely clamped at any height by the movement of a lever.

The trestle is composed essentially of a channel beam to which is attached malleable heads into which iron pipes are fitted by standard threads; any part may thus be readily duplicated, and when not in use, or when they are to be shipped, they can readily be taken apart and packed in small space.

They are made by Peck & McCollom, Ballston Spa, N. Y.

A Plainfield (N. J.) daily paper noticed something unusual about a locomotive pulling one of the "Royal Blue" trains between New York and Washington, and inquiring into it found a test was being made by some Stevens Institute men "to determine the merits and economy of the new *double compound* engine . . . over the *old style, straight line high pressure* engine now in common use." "Instruments are used for testing wind pressure, the stroke of the pistons, the revolution of the fly-wheels," etc., and we are told that amongst other things that have to be done by the "young engineers" who are thus "enlightening the railroad company" and at the same time gathering material for a graduating thesis is, a count of the passengers carried.



Improved Cutting off and Dovetailing Machine.

Improved Cutting-off and Dovetailing Machine for School Desk Seats and Backs.

This machine is designed for cutting off material to lengths, gaining and dovetailing it, for the seat and back irons for school desks.

It is constructed on a substantial iron frame with joints planed and securely bolted, supporting the working parts which are made strong and durable. After the strips to be worked are planed to a thickness they are brought to the machine and cut off to lengths, both ends being cut off at one operation by equalizing saws placed on the horizontal shaft that carries the heads for gaining. The gaining is accomplished at the same movement by means of special gaining cutters attached to slotted heads shown. The saws and heads are adjustable on the shaft from 16 inches to 40 inches.

This horizontal shaft drops automatically below the surface of the sliding table supporting the material, to permit the table to carry the strips to the finishing heads for the gains. The T-slot or dovetail is formed by properly shaped cutters inserted in vertical spindles over which the strips are carried by the sliding table having arrangements for holding the stuff rigidly as it passes over the cutters.

The vertical spindles are adjustable for different lengths of strips and also have vertical adjustments for different depths of slots. For some styles of seats and backs an auxiliary pair of vertical spindles are placed after the first pair for cutting a clearance space for inserting the iron after the strips are glued together. A set of vertical spindles and cutters may be added when desired, to finish the ends of the strips, thus completing them for gluing together.

The several arbors are of steel, large in diameter, and run in long self-oiling bearings. The countershaft is placed in the end of the frame of the machine, giving good lengths of belts. With this machine a great saving of time and labor is accomplished, and uniformity in distance and length attained.

The makers are J. A. Fay & Co., Cincinnati, Ohio.

The Usefulness of War.

A certain writer who has distinguished himself as a war correspondent has recently relieved his mind of some very excusable chagrin regarding the efforts being made to call the art of war by its proper name. It seems as the world gets wiser some of our old follies and barbarisms are getting out of place in modern civilization, and that the average citizen has a very reasonable reluctance to submit his throat to a carving knife, or to make a shot bag of his body to give a jingo an opportunity of getting into fame and a generous salary. It is, of course, a pity that those interested in mutton should be restricted in butchering the sheep, and that certain politicians with an eye on glory and contracts should have to seek them among the living rather than among the dead. The claim that the manufacture of war material has done much to develop the useful arts, is no excuse for its continuance. Because arms of precision are necessarily finely finished, it does not make their use in the successful perforation of human brains a bit more humane than when a bullet was rammed into a Brown Bess with a mallet, and it made a hole as large as a robin's nest. The waste war material of the last twenty-five years that will have to be dumped into a scrap pile would probably pay half the taxes of the country. It may be that the majority of people yet think that the best way to settle a dispute is

to rapidly annihilate the opposing party. Some day they will know better, and the greatest crime of modern times be no longer possible. For the world of labor this will be a godsend.—*Age of Steel.*

The Armstrong Boring Tool.

The accompanying illustration is of a new form of boring and inside threading tool, which has been brought out by the Armstrong Bros. Tool Co., 78 Edgewood avenue, Chicago, Ill.

The construction of the tool will be very readily understood from an inspection of the drawings, where, as will be seen, the bar can be extended from its holder to any desired length to suit depth of hole, and can be clamped by the binding screw which closes the split hub.

Two different forms of caps are supplied for the end of the bar, one of these holding the cutter at right angles, the other at 45 degrees, as shown. The cutters may be of self-hardening or any preferred kind of steel; they are relatively small and can be ground to shape from the bar, nicked and broken off, when they are ready for use.

The wrench shown fits the square head of the clamping screw and also passes over the cap at the end of the bar, so that the slot across its face engages with the cutter, and thus the cap is tightened.

Tools may be double-ended, as shown in one view, and when set at 45 degrees angle can be used in square corner, as shown.

It is especially well adapted for inside threading, as the cutters for this are easily made and replaced.

At present it is made in two sizes, the smaller one having the tool-post shank $\frac{1}{2}$-inch by 1 inch and a $\frac{3}{4}$-inch bar for $\frac{1}{4}$ inch square cutters, and the larger one $\frac{5}{8}$-inch by $1\frac{1}{2}$ inch tool-post shank, $\frac{15}{16}$-inch round bar, $\frac{5}{16}$ inch square cutter.

Other sizes are to be made as demand indicates.

American vs. English Locomotive Cabs.

Our English contemporary, *The Engineer*, seems really to be unable to discuss a question of the relative merits of American and English practice in relation to locomotives.

Its issue of April 13th contains a very temperate, well written and interesting letter by Mr. Hugh Sharp, of Abilene, Texas, in defense of the American cab and decent protection for enginemen. Mr. Sharp states some very suggestive facts bearing upon the matter, and closes as follows:

"Finally, permit me to ask you if you think good driving and firing are dependent on the men, in the first place, being compelled to stand, and in the second, being imperfectly protected from the weather? If you do, and would devote a short space to explaining your reasons for so thinking, it would be of great interest to some of your readers on this side of the Atlantic who have run English and American engines, and who are, as yet, unanimously in favor of the footplate arrangements of the latter."

Most editors would feel some obligation to treat such an appeal at least courteously, even if unable to give a statement of reasons asked for, but here is what *The Engineer* says in reply:

"Mr. Sharp's acquaintance with English locomotives appears to be a thing of the past. What is the advantage to be gained by carrying a running board over the top of a 7 foot or 7-foot 6 inch wheel? Why not put a gangway at once with hand rails at either side on the top of the boiler? All tender locomotives of modern construction are either fitted with permanent seats or with seats which can hook on. The American 'engineer' appears to be a very fragile creature. Even in fine weather he has to be treated like a hothouse plant. Perhaps if he thought less of his own comfort and more of keeping a proper look-out, there would be fewer of those accidents for the occurrence of which the United States railway system possesses an unrivaled pre eminence."

An electrical contemporary stated that if π instead of 10 were the basis of our numerical system, the ratio of the circumference of a circle to the diameter would be unity. This, of course, is quite funny, but not so funny as calling it in its next issue "a slip of the pen."

On the Cultivation of the Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

I hardly expect to place before the readers of the AMERICAN MACHINIST another problem which will call forth as much inventive effort as the problem concluded in my last article upon this subject, in which I presented the remainder of the solutions given to problem No. 5. However, the interest which has been taken in each of the problems thus far presented, encourages the belief that the problems announced herein will call forth some novel mechanical movements.

I will present, this time, *two* problems, which will be referred to as problems No. 6 and No. 7. No. 6 was suggested by Mr. Fred J. Miller, in the AMERICAN MACHINIST of July 20, 1893, in one of his letters written from the Columbian Exposition. Among the exhibits he discovered a peculiar movement actuating the tool of a lathe used for backing off milling cutters, and he remarked that perhaps this would be a good problem for me to present. Those who desire to attack this problem will do well to turn back and carefully look at the engraving of the lathe, as well as peruse Mr. Miller's description of this lathe (written under some difficulties, which he explains) before studying the diagram, Fig. 1, in the present article, with which I have endeavored to illustrate the problem.

Referring now to this figure, I will quote from Mr. Miller's article:

It will be noticed that there is a lead-screw in front which is driven by change gears in the usual manner, and the carriage feed is by the nut, so that it is positive and at a known rate. At the back of the bed is a shaft which runs along the bed the same as the lead-screw does in front, and is also driven from the spindle by a separate set of change gears which are at the rear of those that drive the screw. At the foot of the lathe this shaft carries a spur gear and

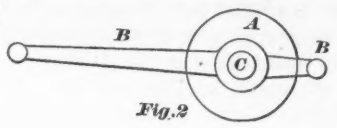


Fig. 2

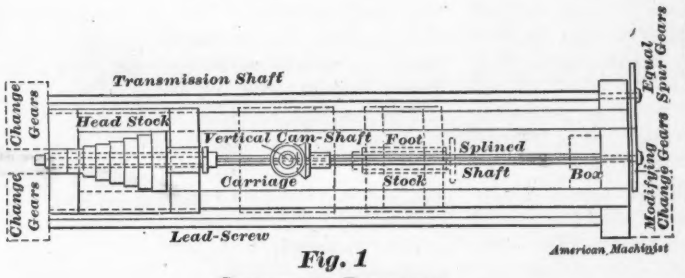


Fig. 1

INVENTIVE PROBLEMS.

drives another shaft which is splined and runs through the middle of the bed under the carriage. On this shaft is a bevel gear which drives another bevel gear, the latter being at the lower end of the shaft on which the cam, Fig. 35, is placed. Now, it is evident that by choosing suitable gears at the head of the lathe this shaft at the back and the cam can be driven at the proper speed for the number of teeth that may be in the cutter.

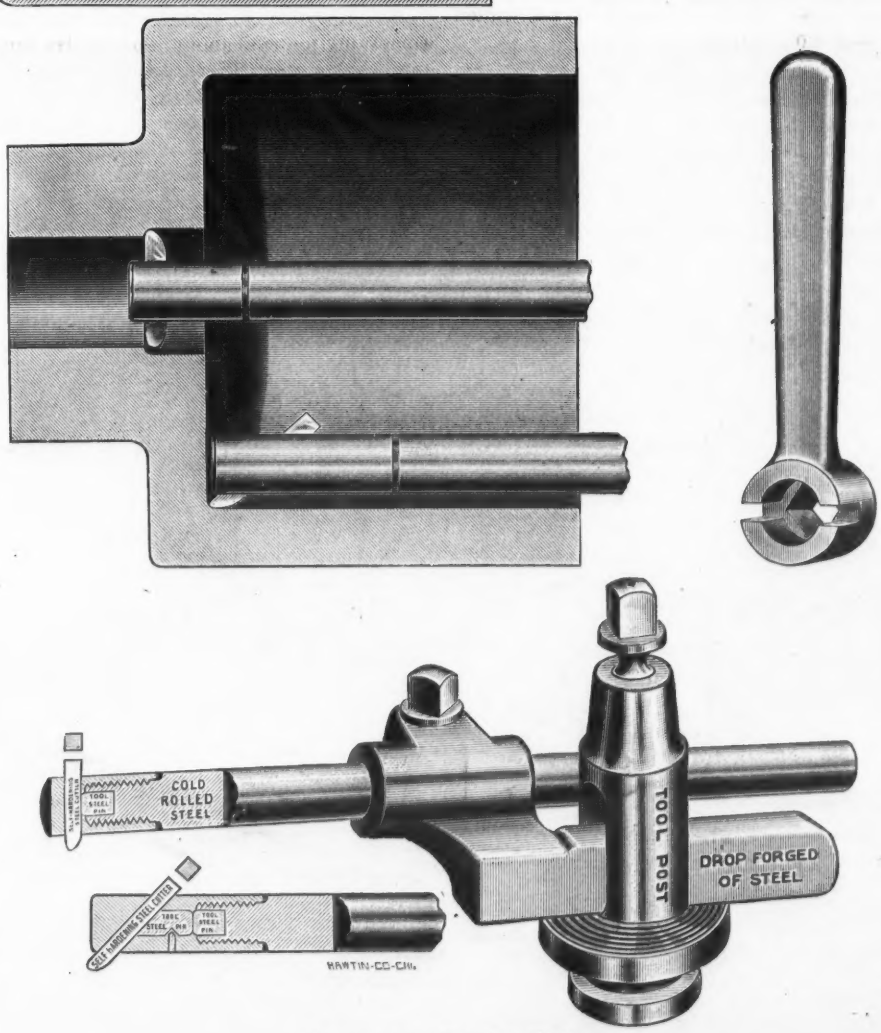
It may be noticed also that there are gears attached to the lower end of the lead-screw; these being a regular set of change gears which drive a stud that enters the end of the bed and disappears within a box formed there; this box being covered, and remaining covered, because the attendants thought it would not do to let me see its interior without special permission from Germany. It is evident, however, that the object of this is to modify the motion of the splined shaft which runs through the center of the bed, this modification being necessary to suit the angle of the spiral of the teeth of the cutter. Taking a cutter such as is shown in the machine, for instance; as the tool is fed along in the usual direction the in-and-out motion of the tool must be gradually retarded in order to compensate for the spiral of the teeth. Supposing this spiral to be at the rate of one turn in 86 inches, then when the carriage had moved 86 inches the cam would need to have been retarded in its movement as many revolutions as there were teeth in the cutter. Not having been able to get the cover taken off I do not know how this modification is effected, though one way of doing it has suggested itself to me, and there are probably various ways.

It will be seen that the gist of this problem lies in the box which was not opened for Mr. Miller's inspection. It is required to supply, in the position occupied by the box, such mechanism as will give the gradual retardation of the reciprocating motion of the backing tool to compensate for the spiral of the teeth, and I hope that on this occasion Mr. Miller will join the "class" and contribute the solution which suggested itself to him, as stated by him in the extract from his letter above quoted.

In Fig. 2 I have illustrated problem No. 7, which can be made to take a more general form than I have been able to give to problem No. 6.

In this problem *A* is a ratchet wheel, which turns freely on the shaft *C*, when actuated by the rock lever *B* and a pawl mechanism. The shaft *C* is more properly a spindle which does not turn in its bearings, the other parts shown in the diagram turning (as stated) upon it, and being supported by it. Now, it is required to add such mechanism to these parts that when the longer arm of *B* is moved alternately up or down, the ratchet wheel *A* shall move through the same arc during the upward motion of the arm as it moves during the downward motion, and in the same direction, under the restriction that *all the added mechanism shall be connected directly with the shaft A or the rock lever B, or both, and that no outside support or connection for the added mechanism, other than these parts, shall be employed.*

In conclusion, I will say that I have been compelled to solve this problem, observing the restriction stated therein, in the designing of a machine for which I am now preparing the working drawings, and that I have succeeded in obtaining a highly satisfactory solution.



ARMSTRONG BORING TOOL.

An English View of Our Armor-plate Frauds.

After reviewing the story of the fraudulent practices in connection with the manufacture of armor-plate at Carnegie's, *The Engineer*, of London, comments upon it as follows, and, we are bound to say, with much justice:

"The whole story is remarkable; we all are naturally inclined to sympathize with Mr. Frick, who is best known in England by the pluck he displayed when he was stabbed; but we are bound to say that it needs very strong bias to read this story without great disgust. The whole transaction is as deliberate and cold-blooded an affair on all sides as is often to be met with. A little 'mosaic' work and plugging up of blow-holes we have heard of before now, but undesirable as this is, it is nothing to what is here reported. Let us sum up the features. From November 3, 1892, to September 16, 1893, the plates are made in full knowledge of the Government requirements set forth in a thorough and careful system of tests. Blow-holes are systematically plugged up, returns systematically falsified, and plates after selection sent off at night to be specially treated. Who would Messrs. Carnegie have us to consider responsible for this? Is their system such that the manager of a special department can be a man of such power, and so full of misdirected zeal and crooked ways, that he is able to employ furnaces at night and carry out all that has taken place without the suspicion of those over him? How comes it that the directors are always absent at the time required? The value of this question depends much on the time elapsing between

the selection of a plate and its dispatch to be fired at. Mr. Schwab presumably is this powerful man of misdirected energy, this habitual deceiver of his employers and cheater of the United States Government suggested above, for he is selected as the culprit on whom the thunder is to fall; he is 'removed.' From what—from Carnegie's Works? Not at all. Only 'from all connection with the armor department at Homestead, except so far as concerns the erection of new plant.' Well, readers can form their own conclusions, but probably they all will concur in the reflection that it is well that Messrs. Carnegie have satisfied their present employers, for we doubt if orders for armor would readily come from elsewhere.

"The picture is not, however, a pleasing one from any point of view. The deliberate plans laid by the workmen and their solicitor, of course, suggest the desire to make all the profit possible out of the fraud that was going on rather than stop it. The fraudulent dealers, no doubt, got nothing more than their deserts, but the method of catching them could only be justified by the conviction that the directors of the works were themselves the evil-doers. Lastly, we cannot but regret that the United States authorities allowed their excellent system of inspection to be so completely defeated almost with impunity, for the penalty is but slight, accompanied as it is with continued orders for armor. We fail to understand the consolation found in the fact that the bad armor was of the thinner kinds, and we fear that great discredit will be done the United States manufacture of armor, which has hitherto been something more than a successful achievement—it has been phenomenal."

Improved Force Blast Blower.

We illustrate herewith a new design of casing and journal box recently brought out by the P. H. & F. M. Roots Co., of Connersville, Ind. By the use of the ribbed cylinder greater stiffness and rigidity with less liability of deformation during the boring or subsequent use are secured, and the ribs at the ends extending from the journal box to the outer edge greatly stiffen that portion of the machine.

This latter feature is incidental to the introduction of a new form of journal box which is shown in longitudinal and cross-section in the smaller views.

The bearing consists of a phosphor-bronze sleeve which is tapered outside from the middle to both ends. The sleeve is slotted entirely through the metal at the top and almost through at the points on the side of the sleeve where the iron segments meet. By this arrangement the sleeve presents an entirely smooth surface to the journal at all times, and if any wear takes place the metal will readily yield to the action of the iron wedge when forced into the box. Six iron segments or wedges are turned up straight on the outside to correspond with the housing of the box and bored inside to the taper of the sleeve. These segments are inserted from both ends of the box and are controlled by three adjusting screws, as shown. If the wear takes place in the bottom of the bronze sleeve the lower wedges are forced in sufficiently to take up the wear and bring the journal to its original central position.

The wear is taken up in any other part of the box in the same manner, and it is apparent that no endwise movement of the bearing is necessary in taking up wear.

The space between the ends of the wedges in the middle of the box is utilized as an oil chamber, and the journal continually runs in oil, this, with the facilities for adjustment, making a box which the makers expect to prove well adapted to this service.

LETTERS FROM PRACTICAL MEN.

Making Drill Jigs—Accurate Screws.

Editor American Machinist:

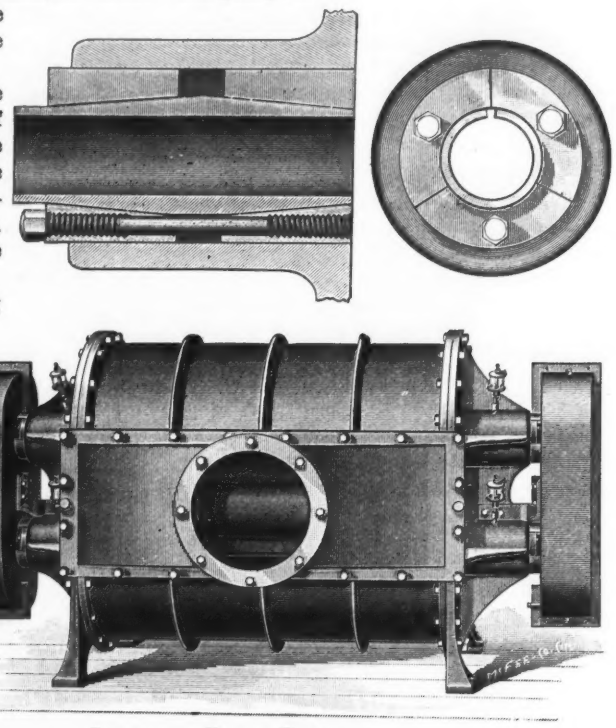
In your issue of April 5th, Mr. E. Lawrenz says: "A drill jig to be of any value whatsoever must be made correct."

I suppose what he means to say is a drill jig should be made good enough for the purpose for which it is intended to be used.

As there are many different methods for making drill jigs and templates, no doubt each shop will use the one they think will give them the best results in the end.

No doubt, holes can be bored to within a limit of from .003″ to .005″ on the milling machine, and for some kinds of work where interchangeability is not desired, the above variations can be allowed.

The kind of a milling machine Mr. L. thinks he would like to have for jig work is now on the market, and has a very fine graduated dial on spiral bed screw (we have one in our tool room), and I have no doubt whatever but the screws are made quite near correct, and I will say here that if other parts of the machine were made as correct as the index screws, we could obtain a nearer degree of accuracy than with others.



Improved Roots Blower.

If screws are the best attainable, and other parts of the milling machine, such as the bevel gears that move the knee, the end-thrust bearings, the scraping of sliding fits, etc., are not correct, there will be variation in results.

The method of using a cutting tool for this class of work in the milling machine is not nearly so convenient as using the ordinary boring tool in the lathe.

If you will allow me to depart from the question of drill jigs, I would like to say a few words about the much talked of accurate screw. Having had considerable experience with the accurate screw, I have come to the conclusion, long ago, that the manufacturers in this country have not paid much attention to accurate leads of screws, and hence a great deal of trouble and expense. How many shops do we find with a set of screw limit gauges to make their machine screws to?

Do not the larger number of them get a tap made of some size near standard, never paying any attention to the lead, then stick it in a common coal fire, and then into the water and oil, then you have your standard tap? The next operation is to get a piece of some kind of metal (does not make much difference about the length, of course), tap it out, and you have a screw gauge (or, as we usually say, a standard hole). Now, is this right? The most of your good readers will say, "No," and I am sure that many of them do better than that. Surely the demands for screws, nuts, bolts, etc., that will always be the same size, or so close as to allow of duplication, will cause us to investigate the question a little closer.

Some years ago we had no good method of measuring the diameter of screws or taps, but we cannot use this excuse now, for the B. & S. Company make a special micrometer for this purpose, and I think every tap, manufacturer, and tool room should have one, or its equivalent. Have a good lead-screw in your tool-room lathe, as well as having a lathe that has first-class workmanship. See that lathe is leveled at least once a month, and I believe you will see your way clear to pay at least as much attention to making good standard screws and taps as to standard reamers, standard plugs and rings, standard mandrels, etc. In fact, adjustable taps are fast coming into use. The position I held some time ago, called me to investigate somewhat into the question of whether the square thread was preferable to the angle thread. I spent several hours one day talking with one of the leading tap and die manufacturers. He said that he believed one of the strongest reasons why we used the square thread so much was that our "grandfathers used them." I will make a long story short, and say we were led to believe the angle thread was the best, using an angle of 29 degrees—14½ degrees on a side.

I am well aware that there is much to be said in favor of using the square thread. There is also much to be said in favor of using the angle thread.

The latter will allow of smooth threads and good fits; you can also make use of dies for roughing, and in some cases finishing. I do not wish to be understood as advocating dies when the lead of screw is desired to be accurate.

A thread with sides on an angle is much more attractive to the eye, and so far as my knowledge goes, I believe it is the best for shop use.

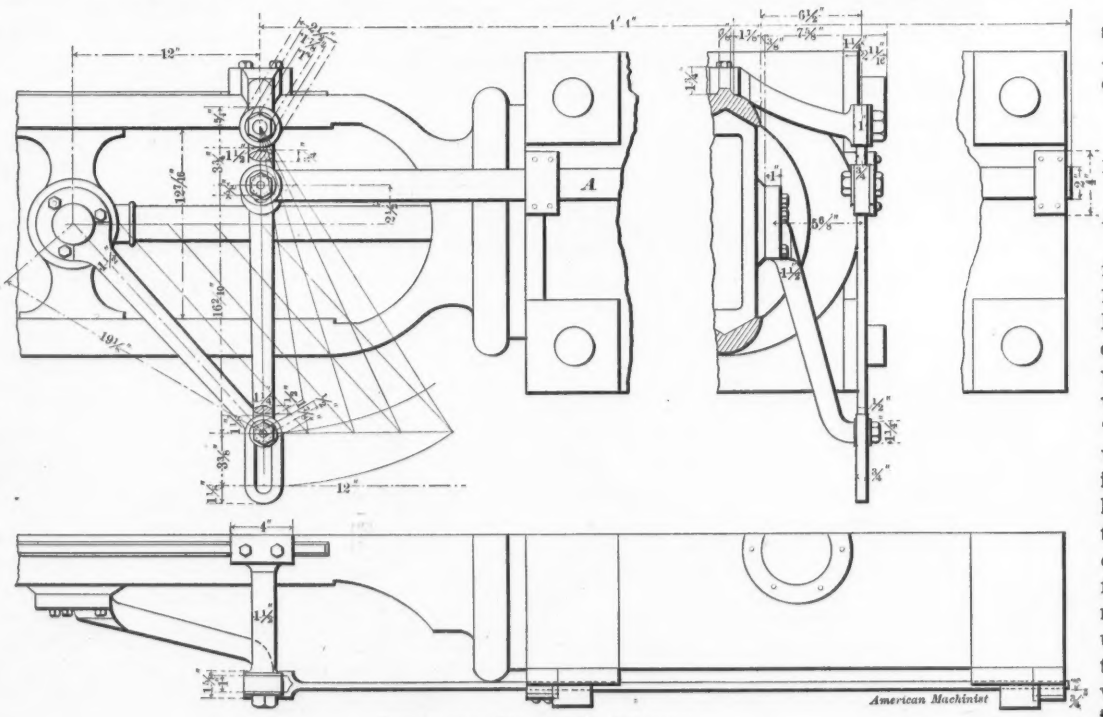
J. A. McGregor.

Indicator Reducing Motion.

Editor American Machinist:

The accompanying drawing shows a design for an indicator reducing motion to be used on the engine in the mechanical engineering department at the State College of Kentucky.

The various designs of indicator rigs presented in your paper of late, suggest to me that perhaps the accompanying design might interest your readers.



Indicator Reducing Motion.

The arrangement enables very short cords to be used. In the bar *A* studs are placed for the purpose of attaching the indicator cords.

U. A. Garred.

Human Nature in a Machine Shop.

Editor American Machinist:

I have read the communication from "Presto" in the issue of the 12th, entitled "Human Nature as a Factor in the Machine Shop," and deem it a subject, as you suggest, worthy of further discussion. I would like to hear more from "Presto," and, no doubt, others would, regarding his own experience in dealing with the human nature he has found in the machine shop—there is, most certainly, a sufficient quantity of it with graduations too fine to be measured by any micrometers we have got around the shop up to date. It always pays to rub the fur of human nature the right way—but the greatest difficulty lies in finding out just which way is right. The most of us are not mind readers, fortunately or unfortunately, and sometimes you may spend several days, weeks or months trying to learn which way to rub a man to get some profit out of him, and finally be obliged to admit there is none in him, when worked in a machine shop, under any circumstances; and you might better have paid him off after his first day, which was your original impulse.

A simon-pure mechanic, a man of good moral character, and every-day horse sense, does not need to be studied; does not have

any refractory fur sticking up which needs to be stroked in any special direction.

He comes into your shop to do what you want him to, and what he gets paid for—and the best way to get profitable results out of him is to let him alone—if you do not treat him civil he will quit; if you want to get more work and more profit out of him than you are getting out of any other man in the shop, you have got to give him *more money*, or its equivalent; fine treatment will help some, but it simply is not in it with fine clothes and other luxuries which big pay will supply.

The sympathy of good fellowship is nice and will reach a long distance, but financial sympathy goes farther—the more money there is judiciously invested in the business, the greater the profits will be—whether it be invested in equipment or paid to men who return an equivalent for all they get. You pay men to work for your interest; if you have any who are not doing it, find out why they are not, and if no satisfactory arrangement can be made, put them out, and get others who will work for your interest, body and soul. If your equipment is out of order, fix it up—if it is behind the times, and cannot be fixed up, throw it in the scrap and buy something modern; you cannot increase your profits by hanging on to it in its present condition.

Do not hesitate—he who hesitates is lost. Do not prolong an agony—life is too short. Do not tolerate grumblers or sore heads—fix them up or fire them out.

In a shop which employs but a handful of men social considerations are far different than where there are five hundred to handle; by constant association for several years with one or two men you may be able to find their soft side—but that depends on how ready they are to show it. One man may put forth extra exertions when handled in a certain way, while another will come to a dead balk under precisely the same circumstances.

While it is policy to be polite and courteous to everybody with whom you come into contact, and to duly show your appreciation of any one's efforts in your behalf, money is what talks; everybody likes money. If there is anything better to rub human nature the right way with than *money*, I want to see it.

To cite one case in my experience: A certain machine had been run for six years under various supervision, and in all that time the greatest product ever obtained was 65 pieces in ten hours; by fixing a few paltry tools, increasing the feed, decreasing the speed, and adding 25 cents a day to the operator's pay, *one hundred and twenty* pieces per day was the result.

What caused this result? Was it the change of speed and feed? Was it the advance in wages, or a combination of the whole? Do I hear some one sneer and say that on this theory all that is necessary to get increased profits is to increase the pay? Well, may be it is; who knows? Who has tried it and failed?

If you want to get profit out of your machine shop, employ a superintendent who knows the difference between a good and a poor equipment of both tools and men for the work in hand, give him absolute authority to run things as if he owned the whole business, and do not lose sight of the fact that he has some human nature, and can appreciate square treatment fully as much as any lathe hand in the shop. It is folly to talk about studying the nature of four or five hundred men, among whom there is an average of two or more changes a day; they have to be considered as equipment. When a man has been in a shop long enough to know that he is dealing with a foreman who thoroughly understands his business, knows how long it takes to do a job, and, in general, knows what he wants, and is determined to have it, and when he knows that more and better work means more and better pay, and also learns that there is absolutely *no appeal* beyond that foreman's decision, then you can expect profit from your man.

Now, let us consider the question of accepting suggestions from the workmen. There are some men who have a way of dropping a valuable suggestion in a manner and under such circumstances that it would be thankfully accepted by any foreman. Again, there are other men always ready with a big mouth jam full of fool schemes, which they spit out regardless of opportunity, and always insist on cramming them down your timid foreman's neck, and will take offense and sulk for a month should he decline to yield to their superior judgment.

You cannot handle hogs with white kid gloves. Such men never find out that they have not been conducting themselves properly until they have been kicked and clubbed from shop to shop until they are too old to work.

But the original question still remains, viz., what is the greatest incentive to make a man hump himself in your machine shop? Is it big wads of money? smooth treatment? fear of getting fired, or all combined?

W. H. CHAPPELL.

As to Drill Chucks.

Editor American Machinist:

I am tempted to trespass on your valuable time by a remark of Mr. John J. Bingley's in your current number. Speaking of "Drill Chuck Improvements" he says the one illustrated by him is more simple and cheaper than one illustrated by Cleveland Twist Drill Company in your recent issue. I think nearly every mechanic will take exceptions to that statement.

It is not my idea of *mechanical* simplicity to unite two parts of a mechanical device like a drill chuck that should be a unit in itself—so that when you have one part you have it all—by means so uncertain as a piece of plumber's chain. Again, who of your readers would be willing to work long at a drill press where that little loop of chain was ever ready to seize and mutilate his fingers? Neither is it my idea of *mechanical*—please note I underscore *mechanical*—simplicity to so construct a device of this kind that one hand *must* be constantly occupied to hold up the locking collar—or it will lock itself—perhaps at the moment least expected or desirable; self-locking devices are good in the proper places, but in my opinion a drill chuck is not the proper place for such a device. The chuck should stay open when opened—and stay shut when shut. The parts should all be so constructed that it is *one*, and not several pieces—held together by chains or strings—which may be broken and the parts consequently lost or separated.

J. D. COX, JR., M. E.

A Doctor's Compound Engine.

Editor American Machinist:

Don't be too hard on the "Doctors," notwithstanding their ideas on mechanical subjects are often very faulty, and even in their own profession they sometimes commit blunders. We have known good things to emanate from physicians.

The Kentucky Doctor, referred to in a recent issue, has certainly undertaken a large contract by attempting to "beat the steam engine" by the use of compressed air unless he can get the air, in this condition, free of cost.

We do not know when, or where, the compound engine was first introduced, but distinctly remember having seen one of these some 35 years ago. It was invented by a *doctor* and was exhibited at the Ohio State Fair, held in Dayton at that time. As might be expected the design of this engine was crude and the workmanship poor, but the novelty of the thing made it attract a good deal of attention. We furnished steam for the engine, which was a small item, for it was only a working model, and imperfectly demonstrated the utility of the principle involved. By an ingenious device steam could be worked through both cylinders, or only one, as desired. When worked in the high-pressure cylinder alone the speed obtained would be about 100 revolutions per minute, and when turned into the larger cylinder, the motion would at once go up to 200 or more, the throttle valve in the meantime remaining untouched.

This was the only means at hand of showing the effect of expansion.

The enthusiastic inventor (we cannot now recall his name) may have felt himself treated with an air of commiseration, for we could but regard the idea of exhausting steam from one cylinder to another as very absurd. We were at that age when young men usually *know* a great deal.

The increased motion referred to was attributed to the freer action of the large piston, when steam acted on it, than when shut in and subject to more or less compression. Whatever there may have been of this, subsequent developments have shown that the Doctor's views were sound, and, perhaps, entitle him to a share, at least, of the honor due the originators of the compound engine. It was, doubtless, the least of his expectations that steam would be passed through four cylinders before reaching the full limit of expansion.

Just here we are tempted to add a word of comment on present practice in compounding cylinders, not from personal experience, but by putting together the views of others, we conclude that this principle is carried too far, when four cylinders are used. In marine practice, however, there are evidently conditions that require the use of the greater number.

It would seem as though engineering science had well-nigh reached the limit of economy, so far as the heat energy stored in steam is concerned; at least in connection with the steam engine. It seems highly probable, however, that a further conservation of this energy, in and about boilers, may be effected without adding expense unwarranted by the gain. "QUIRK."

A Hint in Cube Root.

Editor American Machinist:

This is presented as giving a shorter cut in extracting the cube root of numbers than is generally used, inasmuch as the method of finding the trial divisor is shortened considerably. This is not a new method, for it has been used by my father, Mr. Henry F. Colvin, for at least twenty years, and although it may have been used by others, I have never seen it in print, and believing it will be of use to those engaged in such calculations, give it for what it is worth.

The first figure of the quotient is found as ordinarily directed, and it is not until the second trial divisor is reached that the plan is found to work and save figures. Then, instead of squaring the quotient figures already found and multiplying by 300 for the next trial divisor, we simply square the last quotient figure, and place below the last final divisor, and add together the numbers comprising all except the last previous trial divisor, adding two ciphers, and we have the next trial divisor. This is better illustrated by example, and we take the number 4,088,324,799 to find the cube root.

```
 300  | 4'088'324 799/1599
 150  | 1
  25  | ------
 ----
 475  | 3088
  25  | 2375
 ----
67500 | 713324
 4050 | 644679
   81 | ------
 ----
71531 | 68645799
   81 | 68645799
 ----
7584300
  42930
     81
 -------
7627311
```

After finding the first figure, which is 1, we find the next trial divisor by squaring this and multiplying by 300; this goes 5 times, so we multiply 1 by 5 and by 30, and place it below the 300, and place the square of 5 (25) below this, making 475 our final divisor, as shown, and in accordance with all rules, or most of them at least.

Now, for the next trial divisor we simply square the last figure (5), and place it below the 475, as shown, and adding two ciphers, after adding together the numbers inclosed by the brackets. This gives us 67500 for the next trial divisor, and proceeding as before, we have 71531 for our final divisor. Our next trial divisor is found in the same way, by squaring the last quotient figure (9), and adding to the last final divisor, with two ciphers, together with the other numbers inclosed by the brackets, and which will be seen to be all the numbers *except* the last trial divisor.

This is surely shorter than the usual method, and as it gives identical results, is to be preferred, even where we have a table of squares to refer every time, and where we have no table handy, it is certainly much superior to the old method.

I trust this will find a resting place in many a note-book, as I am sure it will be appreciated more as it is used.

FRED H. COLVIN.

[The cube root of any number can be easily found with the aid of logarithms, thus: Divide the logarithm of the given number by exponent of the root which is to be extracted, the quotient will be the logarithm of the required root. Where a table of logarithms is at hand this is a very easy and simple method, and is one quite generally used. The method is fully explained in connection with the tables given in the text-books, and in Trautwine, Haswell, etc.—ED]

Connections to Indicator.

Editor American Machinist:

I wish to add my testimony to that of Mr. Wakeman in your issue of April 12th. My experience has been that common sense is the best guide in fitting indicator connections.

Last year I had to indicate a Porter-Allen compound engine which, as near as I can remember, was a 12 and 23 by 24, making 200 revolutions a minute.

The indicator connections were brought out at each end of the cylinders, had angle valves at the turns, and united at the middle with a tee on which the indicator was placed.

The L. P. diagrams showed that the steam valves opened too late, and I kept setting them up until, finding it did no good, I concluded to investigate the indicator.

I put an indicator on each end of the cylinder and shortened the connections to about six inches, and then found that I had to take out all the lead I had given the valves.

There was apparently no difference in the cards taken from the H. P. cylinder with either style of connection.

My conclusion is that the pressure of the steam should be considered as well as the engine speed in determining the length of connection allowable.

J. B. P.

Books on Testing Samples of Lead, Copper, Etc.

Editor American Machinist:

In reply to Question No. 150, AMERICAN MACHINIST, March 29th, you state "literature on this subject seems to be scarce," etc. If I judge his question correctly he can find the information desired in any work on blow-pipe analysis; or, if he cares to spend more money, in any book on qualitative analysis. The tests for either one of the metals is simple and certain.

Wiley & Sons, of New York, are publishers of standard text-books on this subject.

P. R. VAN FRANK, JR.

Heptagon.

Editor American Machinist:

Permit me to have my little say on the "Heptagon" discussion. The solution which Mr. Jas. M. Dupries accidentally discovered has appeared in print, for it is given in a book entitled, "Practical Geometry," by Thomas Tate. This book, which I have, was printed in 1864, and is the third edition; but for simplicity in constructing a heptagon it cannot be compared to "Nystrom's" solution as given by Mr. Wm. S. Aldrich, March 8th, for we might as well, by trial, divide a circle into a given number of equal parts, as to try and divide a line into the same number of divisions.

C. A. CALVERT.

It would seem as though all steam fire engines should be capable of propelling themselves to a fire instead of requiring horses for that service. A small cylinder of compressed air might be sufficient.

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A Sample of "Shop Management."

We receive a good many letters, the tone of which is fairly represented by some extracts given below from a letter of a young machinist, who evidently writes with the intention of having us publish his letter in full, giving names, location, and full particulars.

If we should commence publishing such letters as we receive them, we would probably be kept so busy defending libel suits that we would have no time left to attend to other duties, and, besides, it would do no good except in so far as a "horrible example" does good by deterring others from following it.

Our correspondent, after naming the shop, says, "They have the audacity to pay first-class machinists $1.67 a day, and drive them like thieves and slaves. The office window is in the shop, and the general manager, R——, sits and watches to see if any one is loafing, and sometimes he has not the courage to show his face, but sneaks down behind the furniture. I should like for him to work in the shop a while to see how he would like it. From all appearances, it is very little he knows about the business. The foreman, I—— M——, is a regular fool; he wants a job done before it is commenced, and the kind of work they do is horrible. It will not bear inspection, and must require lots of attention and fixing when running, because there is very little workmanship about it. . . . If he would have some system of doing work he could pay more. And the idea of men working there without anything to warm the shop; that crazy foreman says that the men work better without the shop being heated."

Though such shops as this are happily very rare, we regret that the above description does fit more or less accurately too many of them that are to be found.

But there is one consoling feature of the case, and that is that such a method of shop management brings its own punishment. Of course, no first class machinist ever stays in such a place longer than he is compelled to, and while he does stay, sees to it that he gets as little good work done as possible. And who shall blame him? It is, of course, self evident that the "general manager," save the mark! "does not know much of the business," and what shall be said for a machine shop foreman who knows so little of his business as to think that machinists working in a Northern city in winter time work better in an unheated shop?

There is, of course, greater need of a missionary in that shop than there ever was in the wilds of Timbuctoo, and the one who should attempt to do the missionary work would probably have as hard time of it.

It seems incredible that men carrying on machine shops in an enlightened country, where so much has been done to prove the economy and profitableness of good wages and decent treatment of men, should be so utterly benighted and blinded. It seems only to prove the truth of the common saying, that it "takes all kinds of people to make a world," and we sincerely hope that all readers of the AMERICAN MACHINIST at least will be fortunate enough to be able to keep out of such shops, and we believe they will be, with very few and temporary exceptions. Such shops fortunately do not last long under such management. Either the management undergoes a change, or the shop succumbs to the competition of the shops in which workmen can retain their self-respect and interest in their business—shops in which there is some management worthy of the name, and in which the cost of production is, therefore, far lower.

A Mechanical Horse.

A correspondent sends us a copy of a St. Paul paper containing what is evidently a reproduction of a patent-office drawing of a mechanical horse. This horse's interior economy consists of various spur-wheels, cranks, levers, hinges, springs, etc., all of which operating severally and conjointly are supposed to imitate the motion of a real horse in walking, while the motive power is derived from the legs of the rider who is supposed to sit upon the back of this contrivance and work his feet up and down à la bicycle. Under what theory a patent is granted upon such a thing as a "useful invention" is more than we find ourselves able to comprehend in the limited time we can permit ourselves to study the matter.

It is stated in defense of this monstrosity that the bicyclist does not feel that sense of superiority over ordinary pedestrians that the equestrian does, and this horse is designed to fill this long-felt want. It is stated, furthermore, that when this horse is walking there will be the same action to maintain his perpendicular that there is in the revolving wheels of a bicycle, and that it will be impossible to tip it over. We should judge the whole contrivance to weigh about 1,000 pounds, and the sight of a man mounted upon it and trying to work it up a moderate grade would be a spectacle for the gods. Verily! the fool-killer doth sadly neglect his business.

Alloy of Aluminum and Nickel.

At the last monthly meeting of engineers in New York, some specimens of a new alloy of aluminum and nickel were exhibited which were remarkable. They were sent in by A. E. Hunt, of Pittsburgh, and both were in the form of rolled sheets ¼-inch thick. In one of these a hole about ⅝-inch diameter had been drifted out to about 2 inches diameter cold, and the other, which was a strip about 3 inches wide, 24 inches long had been bent at the middle, the deflection amounting to about 2 inches. It was stated that the force required to do this bending had been about the same as is required to similarly bend a similar piece of 90,000-pound steel, and when the specimen was placed upon the floor and stood upon by Mr. C. W. Hunt until straightened, it immediately resumed its former shape upon being released; in other words, it seemed to be perfectly elastic within the limits named. The alloy is of a beautiful white color and of remarkably light weight. No information was given as to the proportions of aluminum and nickel in the alloy, but it probably contains only a small percentage of the latter, and so far as could be judged it bids fair to be an important alloy in cases where lightness and strength are especially desired.

There is considerable talk about defects and trouble with the cruiser "New York" and other naval vessels, arising, some of it, from original faults of construction and some of it by neglect of proper care. It is gratifying to note that the Department of Steam Engineering, which is under the direction of a practical engineer, is practically untouched by the stories of mistakes, miscalculations and failures. Some auxiliary machinery designed by the Bureau for use on the "New York" was found not to be adapted to its purpose, but was acknowledged nevertheless to be exactly what was ordered by the ordnance officers.

In the case of the "Concord," it is stated that her commander refused to allow her boilers to be inspected as they should have been, and that important repairs were made to the engines without any report of them being made to the department. The whole trouble seems to arise from the old fight between "line" and "staff," and from an apparent desire upon the part of certain line officers to exercise control over details which they can in the nature of things know nothing about, and which it would be better even for their own peace of mind to keep entirely clear of.

One of the most curious situations, perhaps, ever presented by the records of the Patent Office is found in the fact as stated, that Mr. Seymour, who is now Patent Commissioner, acted, prior to his appointment, as patent attorney in an application made for a patent on an improvement in air compressors. This was in 1883, and the application was returned on account of informalities and ambiguity of terms with a recommendation that a competent attorney be employed to present it. The attorney who made the imperfect application having now become Patent Commissioner, is asked to pass upon the application for a reopening of the case.

It is to be noted, however, that many men can learn a good deal of patent law in eleven years—the time intervening between the first application and the petition for its reopening, and as the man who figures as the inventor in the case discharged a number of machinists some time ago because they did not vote to suit him, it is just possible there may be more politics in this revival of the case than there should be. Nevertheless, upon the face of it, it must be confessed there is little encouragement in the incident for those who are interested in inventions and patent matters.

Literary Notes.

DYNAMO AND MOTOR BUILDING FOR AMATEURS, with Working Drawings. By C. D. Parkhurst, Lieut. Fourth Artillery, U. S. A., Assoc. Mem. Am. Inst. Elec. Engrs.

Not only amateurs, but also the more advanced students and electricians will find in this book much that is of interest and value. The author describes such forms and types of motors and dynamos as are simply and easily made, and which will produce fairly efficient results. All the motors built according to the instructions here given are not toys, but are machines that can be used for practical purposes, so that the time in building them will not be wasted; and aside from this, the knowledge and experience gained will be of great aid to all who wish to advance themselves in electrical engineering. Amateurs are assumed to have a fair knowledge of electrical matters so as to enable them to work out intelligently those parts which are not fully described in this book; for the lacking information the amateur is supposed to consult his text-books. In this respect, we believe the book could be improved, as the lack of descriptions of some of the minor details, even if these can easily be found in text books, will be disappointing to many amateurs. Otherwise the subjects are well handled, making the book a valuable and instructive one for all who use it. The first three chapters give descriptions and working drawings for the following machines: A small bi-polar shuttle armature motor of simple construction, capable of driving a small ventilating fan from current produced by primary battery. A simple and fairly efficient small motor for driving a sewing machine, in the construction of which no patterns or castings are needed, can be made from material easily procurable anywhere. A motor of more finished appearance and of greater efficiency than the preceding, being a motor of regular factory made type, with notice of some of the latest advances in the construction of such motors. The fourth chapter gives an illustrated description of the simple method of winding and connecting armatures, showing connection between such drum armatures and the simple armature of but a single loop, with winding and connections for drum armatures of improved form, such as are used in some of the latest and best of machines. The fifth chapter gives a description and working drawings, with simple calculations, for a dynamo of modern type, capable of lighting fifty 16-candle power incandescent lamps of 125 volts. In the appendix some data is given of modern high class motors and dynamos of standard firms and makers.

The book contains 163 pages of reading matter and 71 illustrations. It is published by the W. J. Johnston Company, Limited, 41 Park Row, New York. Price, $1.00.

Our friend, Sterling Elliott, is now a full-fledged editor, having been appointed to edit the L. A. W. publication, *Good Roads*, of which we have received the first number under the new management. As might be expected, it is an interesting publication and is bound to do much for the advancement of civilization. It is published at 12 Pearl street, Boston.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(212) K. B., Brooklyn, N. Y., asks: Are there any kerosene engines built? *A.*—Yes. 2. Where can I get information in regard to this class of engines? *A.*—Write to any manufacturer of gas and gasoline engines, the addresses of several of these manufacturers are given in our advertising columns.

(213) M. S. H., Neponset, Mass., writes: Please inform me if there are any automatic air valves made. I mean one that will release air from an air pocket in a water pipe at any pressure. I have built one and would like to know if it is something new. *A.*—There are valves made for the purpose; but the general design of your valve may be new.

(214) S. K., Mt. Carmel, Ill., asks: Is there any kind of paint with which the inside of a boiler can be painted to prevent it from corroding? *A.*—No; boilers are not painted on the inside. Means for preventing a boiler from rusting are given in answer to Question 24 in our issue of January 11th, current volume. 2. Is there any secret in the method of obtaining solid brass castings? *A.*—No; any good brass molder will make a solid brass casting. 3. At what speed should a 3x5 inch cylinder engine be run so as to obtain its highest efficiency? *A.*—We should run the engine at a rate of about 350 revolutions per minute; within practical limits the speed will not affect the efficiency to any appreciable extent.

(215) E. G. S., Columbia, Pa., asks: Are there any rotary engines made that will work as economically as the reciprocating engines? *A.*—We have not yet met with any. The life of the average rotary engine is so short before it passes into the scrap heap, that but little is known of their performance and capabilities, even when new. The number and variety of rotary engines that have been invented is already so great that but few novelties are introduced at present, most of the modern designs are reinventions. 2. Are there any books published treating on this subject? *A.*—"Galloway's History of the Steam Engine," and "Reuleaux's Kinematics of Machinery," give illustrations and descriptions of very many rotary engines. 3. Is there a rotary engine made that works steam expansively? *A.*—Yes. 4. Is there a rotary engine which has no reciprocating parts? *A.*—Yes.

(216) A. S., Doon, Ia., writes: I wish to make a water grate for a 20 horse-power boiler. It is to be made of fire box steel $\frac{5}{8}$-inch thick. Plates will be $2\frac{1}{2}$ inches apart. These plates will have $1\frac{1}{4}$ inch tubes placed as close as possible. What I wish to know is, can I obtain a sufficient air space? How close can I place the tubes? *A.*—We do not understand the use of the plates of which you speak. The air space between the tubes should be nearly equal to one-half the grate area. The distance between the tubes depends somewhat on the kind of coal used; generally the distance between the water tubes does not exceed 1 inch. In order to obtain a sufficient air space, the general practice is not to place the tubes in the same plane, but place them zig-zag. By this method more tubes will be required than when placed in the same plane, but the air space in proportion to the whole projected grate surface will be greater.

(217) J. J. C., Worcester, Mass., writes: Please inform me if there is a better way for a mechanic, who is a fair draftsman, to become a mechanical engineer, than by joining the school of correspondence. *A.*—It is always best to have a teacher as a guide in studies, time will be saved, and the progress made much easier; this advantage is gained by joining the school of correspondence or any other technical institution. Of course, with perseverance you can become a mechanical engineer by studying at home, and always exercising a close observation and careful consideration of the results of practice, and of doing your own work in the shop in which you may be engaged during the day. Practical knowledge gained in this way is often of inestimable value to the professional engineer. The best course to pursue may also depend on the circumstances in which you are placed, making you the best judge of the course to adopt.

(218) F. L., New York, writes: I have a globe of mercury $\frac{1}{2}$ inch diameter at freezing point. Please inform me how high (in inches) the mercury will rise in a tube $\frac{1}{4}$ inch diameter at 120° Fahr. *A.*—Between 32° and 212° Fahr. mercury expands .018153 of its bulk. The volume of a sphere $\frac{1}{2}$ inch diameter is .065 cubic inch. In raising the temperature from 32 to 120 degrees, the increase of this volume will be,

$$\frac{.018153 \times 120 \times .065}{212} = .00667 \text{ cubic inch.}$$

Dividing this volume by the area of the $\frac{1}{4}$-inch tube, we have,

$$\frac{.000667}{.049} = .014 \text{ inch}$$

for the rise of mercury in the tube. 2. How high will the mercury rise in the tube when the temperature is raised to 600 degrees? *A.*—Just 5 times higher than when raised to 120 degrees, which gives us, $.014 \times 5 = .07$ inch. In these calculations we have assumed that the tube is attached to the sphere, and that at 32 degrees the tube contains no mercury.

(219) E. F. V., Montreal, Canada, writes: I am an engineer and have charge of the machinery of one of the principal saw-mills of Montreal, and having continually to change the speed of some of the machines, I have thought of adopting the regular conical system for driving. As I have already read some parts of a book on the system of transmission, by a French author, I am led to believe that it requires one of the conical pulleys to be concave and the other convex. After some experiments on a small scale, with two continuous speed cones 30 inches long, both having a diameter of $7\frac{1}{2}$ inches at the small end and $13\frac{1}{2}$ inches at the large end, I found that although I was very near successful, still I am not quite correct for the belt, which is crossed. I would like to know if you have published anything on the subject, if so be kind enough to give me the date of the issue. If not kindly give me the proper dimensions to follow. *A.*—For a crossed belt, as in your case, and with cones of equal diameters at the ends, the taper should be straight; in short, they will be equal and similar tapering in opposite directions. For open belts and for various speed ratios see our issue of December 1, 1888, in which comparatively simple graphical methods for determining the diameter's speed cones, and continuous speed cones are given.

(220) C. H. E., High Bridge, N. J., writes: Kindly give me a formula for finding the force in pounds with which a weight will strike in falling a certain number of feet. I have several formulas before me, but they all give the force in foot-pounds. *A.*—It seems to us that you have read the formulas hurriedly; careful reading will show, if the formulas are correct, that not force but stored-up energy, often called kinetic energy, of the body or weight is given in foot-pounds. The average force in pounds will depend on the time during which the weight is brought to rest, or on the distance through which the weight acts in being brought to rest. Two formulas may be used to compute the average force in pounds. To make this plain we will take an example: A weight of 100 pounds falls through a distance of 6 feet; find the average force in pounds of the blow. The first step will be to find the velocity of the weight acquired at the end of the fall of 6 feet; this is found by the formula $v = \sqrt{2 \times g \times h}$, in which v = velocity in feet per second at the end of the fall, or the velocity of the weight at the instant of contact, g = acceleration due to gravity which we shall take at 32.2 feet per second, and h = distance through which the weight has fallen, namely, 6 feet. From this formula we obtain:

$$v = \sqrt{2 \times 32.2 \times 6} = 19.6 \text{ feet per second,}$$

for the sake of simplicity let us say 20 feet per second. Now, the velocity of the weight at the instant of contact being 20 feet, and at the end of the blow the velocity being 0, we have for the mean velocity of the blow $\frac{20 + 0}{2} = 10$ feet per second. Now, suppose this weight strikes a pile and drives it $\frac{1}{2}$ inch into the earth, the time in doing so will be, under the above conditions, $\frac{1}{240}$ second. Now, to find the average force in pounds of the blow, we shall first take the formula:

$$f \times t = m \times v \qquad (1)$$

in which f = average force in pounds, t = time during which the force acts, $\frac{1}{240}$ second in this case, m = mass of the weight which is equal to the weight divided by 32.2, hence in this case the mass will be equal to $\frac{100}{32.2} = 3.1$, v = velocity of the weight at the beginning of the blow, hence $v = 20$. Substituting these values for the symbols in formula (1) we have:

$$f \times \tfrac{1}{240} = 3.1 \times 20,$$

hence:

$$f = \frac{3.1 \times 20}{\frac{1}{240}} = 14{,}880 \text{ pounds.}$$

Second, we may use the following formula:

$$f \times s = \tfrac{1}{2} \times m \times v^2 \qquad (2)$$

in which s = the distance through which the force acts; this, according to the condition assumed, is equal to $\frac{1}{4}$ inch or $\frac{1}{48}$ of a foot; all the other symbols denote the same quantities as before. Substituting for the symbols their values in formula (2) we have:

$$f \times \tfrac{1}{48} = \tfrac{1}{2} \times 3.1 \times 20^2,$$

hence:

$$f = \frac{\frac{1}{2} \times 3.1 \times 20^2}{\frac{1}{48}} = 14{,}882 \text{ pounds,}$$

the same result as before.

(221) A. B. C., Philadelphia, Pa., writes: The following questions were given out, about two years ago, by a board of examiners of the Navy Department in examining applicants for master ship fitters. I wish you would give me the answers. Explain tensile strength and ductility. *A.*—Tensile strength is the resistance which a body can offer to a pulling force tending to pull it apart. Ductility is the property of solids, particularly metals, which permits them to be drawn out in length with a corresponding decrease of cross-section, and without any actual fracture or separation of parts. 2. What are the usual tests of mild steel for shipbuilding? *A.*—There are several tests for mild steel. One is the bending test. For this a strip of any convenient width, say, one or two inches, is sheared off the plate, and then bent down cold with a sledge hammer until the surfaces of the test piece touch each other. Plates five-sixteenths of an inch thick and less, whose test pieces will not stand this test without breaking, are rejected. For thicker plates the angle to which the test pieces should be bent is generally specified. Another test is the drifting test. This consists of cutting a test piece $2\frac{1}{2}$ inches wide, and punching a $\frac{5}{8}$ inch hole in the center, annealing thoroughly, and then drifting the hole out with taper pins. The larger the hole after drifting, the better the material; it is expected that ordinary steel plates will drift to twice the diameter of the punch without showing any signs of fracture. Another way to test a plate is to submit its test piece to tensile stress. 3. Name the different parts of an engine lathe, and state how a slide rest of the latest design is fitted. *A.*—It will not be of any benefit to you for us to name the different parts of an engine lathe without giving an illustration, which we cannot undertake to do in these columns. The best way for you will be to cultivate the acquaintance of a good machinist, who can take you to a lathe and point out the different parts, and give the correct names of each. Such a course will be far more beneficial to you than simply knowing the names without knowing to what parts they refer. 4. What are the usual cutting speeds in lathes and planers for cast iron, wrought-iron and brass? *A.*—Cast iron can be turned and planed at 15 to 20 feet per minute; speed for turning wrought iron from 25 to 40 feet per minute; for planing, from 20 to 25 feet per minute; the speed for turning brass is from 40 to 100 feet per minute, and for planing, as fast as the planer can be run, probably 80 feet per minute will be the limit. The speeds in practice vary widely, according to the quality of the metal worked, the character of the cut taken, the degree of accuracy and finish required, quality of the tool steel used, and the character of the machine in use. Experience and good judgment are the only reliable guides for determining the speeds for cutting tools. 5. Describe how you would find the cutting speed of a lathe at work. *A.*—Count the number of revolutions of the piece which is being turned, and multiply this number by the circumference of the turned part of the piece. 6. What is the safe load to be put upon a $\frac{7}{8}$-inch wrought iron bolt in simple tension? *A.*—At the bottom of the thread the bolt will be, say, $\frac{7}{8}$-inch diameter; the area of a circle of this diameter is .44 inch; the safe tensile stress of a bolt should not exceed 6,000 pounds per square inch; hence the safe load will be $6{,}000 \times .44 = 2{,}640$ pounds. 7. What is a surface plate? *A.*—It is a truly-surfaced metal plate used as a test for the production of other flat surfaces. 8. What is a micrometer caliper? *A.*—It is an instrument whose main piece is bow shaped; it has a micrometer screw attached by which very fine measurements can be taken. 9. Describe a hydraulic jack, its purposes and construction. *A.*—A hydraulic jack is used for lifting heavy loads. It is operated by means of some liquid, usually oil, acting against a piston or plunger, the pressure on the liquid being produced by a force pump. 10. What book would you recommend for information on the questions given above? Subjects of this kind are beyond the general knowledge of ship fitters, and yet he is expected to answer them. *A.*—You will need several books for full information on these subjects, but probably a good mechanical dictionary may serve your purpose. The answers to these questions, excepting, perhaps, the first one, should not be beyond the knowledge of a good mechanic who has given his leisure time to a systematic study and reading.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Speed Gage McLauthlin & Co., Fulton St, Boston.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St. N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Engine Castings, 1 to 6 Horse-power Vertical. Humphrey's Foundry, Bellefontaine, O.

American Packing Rings make pistons steam tight. Are simple, durable and inexpensive; write for circular. J. H. Dunbar, Youngstown, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

Screws and screw-making. Post free, $1.25. Spon & Chamberlain, 12 Cortlandt street, New York.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—Emery, Emery Wheels, Grinders, Knife Powders and Sharpeners, Paste & Liquid Polish, Whetstones. The Tanite Co. New York, N Y.; Cincinnati, O., & Stroudsburg, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

Discussion of Tests of Materials—Abstract.

At the conclusion of the presentation of Mr. Tinius Olsen's paper, as given by us last week, the engineers present at the meeting entered upon a general discussion of the subject—"Tests of Materials."

Mr. G. C. Henning had with him a number of test specimens that had been broken in testing machines; among them the one shown at Fig. 1 (page 10). Regarding this he said: "There is always a great question as to what is good boiler steel, and it is very peculiar that when you look at a piece of steel, when it is tested in the machine, you can tell whether or not it is steel which will behave well in a boiler, particularly a locomotive boiler, by a very peculiar marking which appears on the test piece."

[The markings referred to are shown in our reproduction of a photograph of the test piece, and appear as wavy markings upon the surface of the piece towards and near the point of fracture.]

"Some call that the skeleton of the steel. Of course, it is not anything of the sort, but that is a convenient name to give it. When you find that marking in openhearth steel, and the general factors are satisfactory, you can take it for granted that the steel is the best that you can get for boilers. I do not know what is the reason. But many years of experience and investigation of that subject have demonstrated that invariably boilers made from that steel give the best satisfaction. If the specimen is entirely uniform, and has no markings of any kind, then the steel is not good for boilers. Then there is another peculiarity in telling whether the steel is really good or not. Say, for instance, you have a flat specimen; if there is a very gradual reduction of area then that shows that you have about as good a steel as you can get; but, if the steel has a well defined shoulder in it near the point of fracture, however slight,

and then comes down, there is something wrong in that steel."

Mr. Henning also passed around a specimen which he characterized as follows:

"And here is what some people sell for the very best boiler steel, which gives you all the ductility and everything else you want, and when you come to look at it it is nothing but a couple of pieces of wrought-iron and steel welded together. That is, they are put in a furnace and piled, just the same as you pile wrought-iron plate, submitted to extra high heat, and then rolled out together. The result is that the material is unreliable, and when you least expect it there is some trouble with it."

Referring to another specimen (a round one) shown to the members, the fractured surface of which was cupped, Mr. Henning said:

"There is a theory that says that when material breaks it always breaks on a given plane, and that this angle which this plane makes with the line of stress determines the quality of the material. That is, from this angle you can determine the resistance of the material. Now, in the case of steel, of good quality and uniform, the plane of fracture might be inclined in either direction, and in the attempt, as it were, to fracture in both directions one surface is cupped and the other correspondingly convex, the angle of the sides of the cup having some relation to the quality of the material. I have never seen any practical use made of that theory."

The speaker then requested that Mr. Olsen's diagrams, published in our issue of last week, be again thrown upon the screen, and said:

"I think these diagrams are really remarkable. I think I have never seen any more correct, or more regular, and particularly so of the woods. [Fig. 9 last week.] I think they are simply beautiful."

In this diagram vertical height indicates load applied to the specimen while deflection of the line of the diagram to the left indicates the yielding of the specimen corresponding to the given load. Calling attention to the fact that the diagram for white pine showed a perfectly straight line within the elastic limit, or yield point, he said that this showed the wood to be "perfectly elastic. Hemlock is by no means elastic. Hemlock is by no means a desirable wood for building purposes, because it is so irregular, and the fibers are not parallel, and hence some of the fibers may break before others. [Its diagram curves all the way.] But in the case of oak you will notice how very straight this line is. When you get to the extreme test of that wood, it becomes suddenly very weak, while in the case of white pine there is nothing of the sort. You have a gradual sliding of the fibers. [As shown by long horizontal lines of diagram.] Then in the case of ash you see a very decided break and a very good elastic line."

In the case of these steel specimens, they are also very fine. The steel boiler plate here shows the very thing that Mr. Estrada said we do not know anything about. There is a straight line up to that point. [Point of elastic limit.] Unfortunately, this diagraming apparatus, as well as all of the others, does not magnify the elastic curve sufficiently. All the properties for which we use materials are defined by this line [up to the elastic limit], and if this line were drawn to such a scale as to magnify this distance a thousand times instead of five times, as it is here, then the width of this pencil mark would, on this diagram, be at least four inches, and you could draw as many different lines in that, running from this point to the extreme corner, as you could draw pencil marks in these four inches. I pointed that out in a paper which I presented to the San Francisco meeting, and I drew one of these curves on a ten-fold scale, and on a different sheet I drew one with a thousand fold magnification, showing that all the possible errors of observation would be covered by the finest pencil line you could draw, while all the distinguishing characteristics of treating steel by different methods are entirely covered by this thickness of pencil line, and this curve would show nothing, while if the magnification were a thousand times, every different method of treatment of steel, whether you heat it or cool it suddenly, or heat it uniformly to a certain temperature or a higher temperature, would be indicated by the different shape of this line whether it be more nearly straight or less so, and especially where the elastic limit is located. Mr. Estrada said you could not well define the elastic limit. But up there you will notice just where the line deflects, that is the elastic limit, and where it shoots over to the left, that is the yield point. Where the proportionality of extension changes, that is the elastic limit; and where the proportionality ceases and there is a continued stretch without any appreciable increment of loading, that is the yield point. Those are points very well defined, and nothing

Fig. 1.

will characterize those points in material as well as a diagram. Then, on the other end of these curves you will see away up there is the maximum load, and then beyond that the testing machine is sufficiently good to let the weight run back until the specimen breaks at a load very much less than that carried before. I hope that the diagraming apparatus will be so worked out that we will get one that will draw nothing but the elastic curve, and this on a very much magnified scale, then from the mere appearance of that diagram, we can determine what treatment the material has been subjected to. Of course, I do not mean to say that a diagram, except in very rare cases, can be used to measure off elongations or loads, unless you have made all possible corrections for errors of instrument, and temperature and what not. But at least the shape of the curve would be undoubtedly of most valuable assistance in determining the particular influence of whatever treatment the material might have been subjected to.

MR. J. SELLERS BANCROFT: I might say that we have been working on a recording apparatus to meet this point which Mr. Henning speaks of. We have made a number of experiments, and it looks as though we should succeed in accomplishing something. But we have not got it ready to talk about it. We have it magnified on a scale of a little over a thousand times. I believe that diagrams up to the yield point are what we have to look to.

MR. HENNING: In regard to the diagraming apparatus, I would say that the prettiest thing I have ever seen is a photographic apparatus designed and used by Professor Marten, of Berlin. He simply throws a ray of light from a little mirror on a sensitized film. The room is dark, except for that ray of light, and having the mirror move in one direction by the motion of the weight the position of which determines the load on the specimen, and the revolution of this very small mirror throwing the beam of light across the sensitized film, draws, photographically, diagrams just like this, and he can magnify them as much as he likes, because it is only a question of casting the ray of light through a lens on a more or less distant screen. Afterwards he develops them and he has obtained some very beautiful results. Another thing he does is rather unique. He makes a diagram of these minute extensions. These extensions within elastic limit are less than .01 of an inch actual measurement. He has a little apparatus consisting of a movable glass weight, and the specimen moves a diamond point. That diamond point engraves a fine line on the glass, and it is so small that the head of a pin will more than cover the whole diagram. Then he puts that in his lens and projects it on a screen. When thrown on a screen and compared with the observations of other instruments the results are comparable. But it is remarkable how you can make a microscopic picture like this, and throw it on a screen, and check up your results. Of course, he did not intend to check up his results by that diagram, but the diagram was sufficiently good to do that. He uses that only when he tests small objects, such as paper or silks. He has not used it for structural materials.

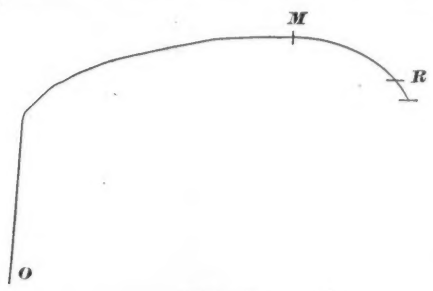

Fig 2.

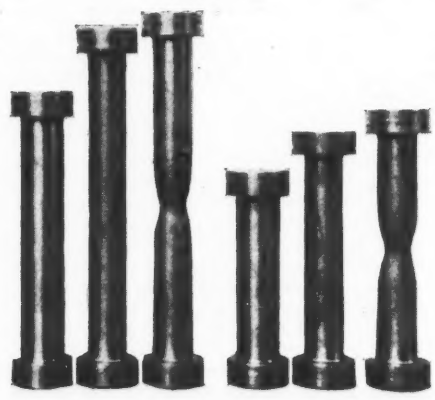

Fig. 3.

Mr. Henning then passed around a photograph, part of which we reproduce at Fig. 3, which shows two tensile test specimens photographed; first in their natural condition before being put into the machine, again when stretched nearly up to the elastic limit, and again when just at the point of fracture. In reference to this he said:

"It is always a question how much does that material extend? If material is uniform the extension should be the same, but we know that when we reach a certain point the general diagram is this (Fig. 2) *M* is the point of maximum load. Take the elongation as measured between the unloaded condition of the test piece and the maximum load and you will find that the percentage of elongation up to the elastic limit is always uniform, whether you test a piece 2 feet, 10 feet or 20 feet long. It is quite independent of the shoulders or length of the specimen or anything. This point (the point of beginning of deflection, Fig. 2) indicates that a test piece which was reducing perfectly uniform, is endeavoring to neck down, or have a reduction, as they call it, and finally the fracture generally occurs in the center of the reduced section (Fig. 3). We generally measure the elongation by taking it between two marks, one near each end of the specimen, and include local elongation in that, and after having observed that—of course, that is observed after you take the test piece out of the machine—if by calculation, as shown in report No. 4 of the Society's committee, you deduct the total elongation from the local elongation, you will get the percentage of elongation. It is very difficult to work out the exact proportionality. In that two-inch test piece we may have 50 per cent. elongation, because the two inches in here elongate vastly more than the rest. But whether that specimen has more or less total length, has a great influence on the recorded percentage of elongation. That, of course, vitiates statements of elongation of material unless you are told on how long a specimen that elongation was measured. But these photographs are photographs of pieces that were tested that way, and in every case the proportional elongation is identical, whether the piece is 2 inches, 4 inches, 6 inches, 8 inches, 10 inches or anything. The elongation in this case runs from 22 per cent. up to 43.7 per cent., while, when you take a correct observation, the actual elongation of that material is a little over 25 per cent. in every case.

Mr. A. E. Mitchell, superintendent motive power of the Erie road, being called upon by Mr. Forney, said:

"I did not come here to say anything tonight, as I have not run a testing machine for 13 years. I am interested though in one subject connected with testing machines, on which if I could get any light it would benefit me, and that is the speed at which a machine should run. I talked with one or two members of the association before the meeting, and I could not get any light on the subject, and I did not think I would bring it up. But it is a fact that you can get different results according to the different speeds at which you run a machine. If a plate is tested on a certain machine, it will give us results like the specification; if tested on another machine at different speeds we will get different results. We will accept the material on the test given on one machine, and on the other we will condemn it."

"The higher the speed, the higher the tensile strength. I was educated on a Riehlé machine designed by Mr. Olsen. It was the first machine the Pennsylvania Railroad had, and I worked that machine for 14 months. I tested over 9,000 samples. The speed of that machine was an inch in three minutes. That is the speed at which I always tried to run the machine."

MR. HUNT: And that is your judgment?

MR. MITCHELL: That is my judgment of the proper speed of a testing machine.

MR OLSEN: You say you tested on different machines. Did you test on the same machine at different speeds?

MR MITCHELL: I never made that test.

MR HENNING: If you test soft steel, especially basic steel, it does not make any difference what speed you test at within your capacity of observing anything about the test. Of course, it is well known that in the Carnegie Works they test so fast that you simply take the man's word for it that it carried that much. But if you know your business you do not let them run a machine so fast. There is a reason why the machine should show higher results when you run very fast, and that is you apply so much momentum through the test piece on to the beam, which is of considerable mass, that it will always keep carrying more. When you come to a rest the machine balances all right. But as you keep on running the weight is always ahead of the load you have on the test piece, and the faster you run the further the weight will be

ahead of the load, in order to counteract the momentum due to the increase of the force applied. If you apply the same force the momentum in the beam will be the same. There is always an increase of force applied. Hence, there is always an increase of momentum which must always be counterbalanced by a slightly advanced position of the weight. But if you run as fast as 2 inches in one minute on the ordinary soft steels, you will not find any difference. When you test boiler steels which have different qualities altogether from the soft steels, there you find considerable difference.

MR. MITCHELL: Do you find any difference between the acid and the basic?

MR. HENNING: Yes. The acid steel always has more carbon than the basic. You can run the Emery machine as fast as you please. Of course, it takes the greatest skill to keep the Emery indicator floating between the marks; but so long as that indicator is floating between the marks, you have always got the load on that as indicated by the machine, but if your machine is running so fast that you cannot observe every point about it, then it is going too fast. I simply see how the machine behaves, and if it behaves well I let them run a little faster. When the machine is a doubtful one I run very slowly, until I find out what the machine is. When I want to know what results I get out of a machine, I calibrate it. If you do not do that, you do not know what the material stood.

PROFESSOR HUTTON: I think there is more in that subject that Mr. Mitchell has opened than Mr. Henning fully covers, while his explanation is of real value. I remember a case which came under my own observation not long since, where a firm in town here wanted to send some copper for fire boxes to the Baldwin Locomotive Works, who were going to send some furnaces to South America, where they have a fondness for copper. They wanted some unprejudiced party to say what the copper would do. The requirement was, stretch 25 per cent., and tensile strength, 35,000 pounds. They asked me what kind of sample I wanted to test. I said, give me at least 4 inches of reduced section taken from the half inch plate. We were running at that time on the old Fairbanks' screw machine, and I found it impossible to give that 35,000 pounds, but I could give them 35 per cent. to 40 per cent. stretch right along, but we could not raise the tensile strength higher than 33,000 pounds. I finally told these gentlemen that I thought the Fairbanks' machine was not the one to test this piece on, because those people down there are used to a hydraulic machine. So they took the specimen down to the Post-office, and got Mr. Starbuck to test it, and got the test all right. I absolutely could not get that by any way by which the old Fairbanks' machine could run. The specifications were based on a hydraulic machine. . . . There is something, I am sure, in the speed at which the test is made beyond this mere inertia of the beam, which, of course, does enter as a problem when two tests are made at nearly the same speed. But where there is a great difference in the speed I think the material comes in.

MR. HENNING: What I said applies only to steels, of course. Professor Hutton is perfectly right, when you apply that to certain grades of steel, as manganese steel, or to Tobin bronze, or copper. The shape of the test piece also has proportionately greater influence on the results obtained than the treatments to which the material might have been subjected, in order to have produced certain results. But in the case of alloys and coppers, you have to be very careful about using the proper speed, and giving the material time to arrange itself. Of course, that higher tensile strength is only fictitious. That is an artificial advantage which you would not find in service in a boiler. They would simply break at a lower load, if the load ever got to that point.

DR. EMERY: It would seem, Mr. Chairman, as though this question of giving the material time to rest came in very closely to this question of speed. I suppose it is pretty well settled—I would like to hear those who have kept themselves familiar with the subject for years, as I have not—that by giving the material rest it will recover a portion of its resistance, and show higher tensile strength for a while when the strain is renewed. I had hoped that that very question would be discussed here. It seems possible that that may have something to do with it. At any rate, I would suggest that this is a very interesting subject of discussion, if some would take it up when there is more time.

MR HENNING: I heard from one gentleman in Pittsburgh to-day, who wanted to come here to speak on this very subject, but who did not get his invitation in time to be present, and he asked me to refer to it, if no one else did. If you test material immediately after it comes from the rolls, the material will be decidedly weaker than if you kept it lying idle from 12 to 24 hours. Our better rolling mills never give you a piece, especially thin shapes of plate or small bars that have not had a chance to recover after being rolled. If you take a sample from a plate as it comes from the roll it will not give the ultimate strength, nor will it show the elastic limit or elongation, within a very considerable amount. So it is often a question of rejection or acceptance whether you allow the material to rest a while before you test it, or whether you test it fresh from the rolls. About the benefit of giving the material rest after having done work, I do not think that ought to come into account with engineers, for the reason that we are not supposed to use material that way. . . .

An Improvement Wanted.

BY W. H. BOOTH.

There is nothing like leather. This appears to be the motto upon which makers of hydraulic presses base their work, for leather is the substance they use to pack both the little ram and the big one of a hydraulic press. In the course of my experience I have had frequent occasion to employ the hydraulic jack. Now, it must

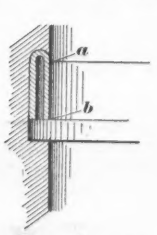

Fig. 1

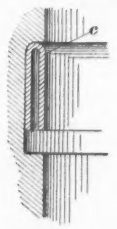

Fig. 2

American Machinist

be admitted that the hydraulic jack, when newly packed throughout, tight and in good order, is a most useful and powerful assistant in many a trying fix. Where brute force is wanted the jack will give this, but it is very trying, indeed, when after all preparations have been made, a jack suddenly begins to leak round the ram. You know at once the cup leather has burst, and if you are away from a source of such leathers you lose a lot of time. Now, in the theory of the cup leather arrangement you ought not to burst a cup leather; they are only supposed to be exposed to a flattening pressure, not to a bursting pressure; nevertheless, they burst. In the ordinary arrangement of jack there is a recess turned in the side of the cylinder, near the top, which is large enough to receive the leather. The cylinder is supposed to be bored a close fit on the ram, the leather serving to make the joint. Now, in theory, the leather recess is supposed to be of the form shown in Fig. 1, the top of the recess being of circular form to fit the curve of the leather, and brought round until it finishes at a thin edge at *a*. Now, from *a* to *b* the leather is supported by the ram, which fits close in the cylinder, and there is no get-away for the leather at any point; it is backed up everywhere by metal. In practice the leather recess may be found more nearly like Fig. 2; there is no return of the crown to *a*, as in Fig. 1, but the corner of the leather is left unsupported at *c*, and exposed to bursting stress, and also to a bending stress when the ram moves and tries to carry up with it the leather, which is tightly pressed against it, with the result of failure at a critical time. I believe jacks are rated for capacity at what they will move when worked by one man, but I have found men who, having put a jack in order, will show it is in order by two of them standing on the lever, and proving no movement of the lever when the ram is prevented from moving by a bridle or other means, and we all know that when work has to be done all available power will be put onto a jack lever to make things move irrespective of nominal ratings.

Now, it seems to me that there is a field for an inventive genius in the case of the lifting jack. Something has got to be devised which will prove reliable and durable, and will not decay and burst, as does leather. Though easily repacked, the little plungers seem equally as crude in their packing design as the rams.

In jacks of the smaller sizes the cup leather is placed round the lower end of the room itself, and the same remarks will apply as to the shape of the recess crown. I believe the cup leather was the invention of the man who invented the hydraulic press, namely, Bramah. There are some things which no one seems able to alter or improve upon. So far, the cup leather has been one of these unalterables. Is this because nothing seems so able to resist the passage of liquids as some fibrous substance? The hydraulic jack cannot afford to work in a leaking condition, for if working against an absolutely inelastic resistance, the leakage of a single drop would destroy all its pressure, and under ordinary conditions a very little leakage is fatal. Anything to supersede the present system of packing must have tightness as an essential.

Since writing the foregoing, I see that Mr. O'Dea has been writing on the subject of cup leathers, and pointing out how necessary it is to use the very best of leather specially prepared for the purpose. Unless this special leather be used, packings rapidly go to pulp, but what I want to see is an improvement on even hydraulic leather, which, even when of the best, is not proof for long against the enormous pressures used in hydraulic machinery.

We hear from time to time of the folly of employing any sort of a man as good enough to fire a steam boiler. While agreeing with this sentiment, I would wish to say that the dissatisfaction with this state of things has tended somewhat in a wrong direction, and we have been sometimes almost led to think that in order to fire a boiler properly a man must know how to read, write and figure, and even add to this some chemical knowledge of the nature of combustion, etc., that he must, in fact, be fairly educated. Now, is there not somewhat of a habit springing up of using the word education in a too narrow sense? Education has come to mean an ability to read and write as a *sine qua non*, together with what further can be added to these practically universal acquirements. The ability to read may help a man to acquire knowledge of use to him, but so will an open eye and a habit of observation, and when I have heard so much of the certificating of firemen, it has struck me that a written examination such as has been suggested would weed out as many really first-class firemen as poor ones. Firing is an art which no amount of so called education can put into a man, and a good fireman has as good a chance of becoming known as such as has a good mechanic of any other sort. If John Smith is found to keep a steady pressure of steam for weeks in succession at a less cost per week of, say, five dollars than has been effected by a previous man or two, then may Smith expect to receive a favorable reply to a demand to share in that five dollars, whether he be able to figure out his safety valve or not. It is desirable for his own sake that he should acquire other knowledge than that of good firing, but as a fireman, for which duty he contracts, and is paid, he is not any more valuable for such knowledge. His round of daily duties, apart from keeping up steam, involves attention to the water level, to turning the blow-off, and to lifting every safety valve lever once daily. He can see at a glance whether the valve is operative; he knows that the weight is where it should be—at the end of the lever. If not at the end of the lever, it is some other body's duty to see that the weight or lever be reduced so that no outward movement of the weight can be made to endanger the boiler. I very much doubt, indeed, whether efforts at self improvement have ever—I speak, of course, in general terms—helped a man to do better for himself in his employment. It is more than likely he will come to be told that he is too good a man for the place he is seeking to occupy more creditably, and his difficulty then will be to persuade some one else that he is good enough for a place something better. He will learn that he has improved himself out of one employ to have to seek another and better. Sir Joseph Whitworth founded certain scholarships with the intention of producing good men in mechanical arts, but he entirely failed in his purpose. They learned more mathematics, and acquired more of other information than were really required, and very few have become practical men I am informed. Some are teachers, others professors, editors, etc., and patent offices, I believe, claim quite a number, but none of them follow Whitworth, who had no education to fit him for his work save what he acquired himself. In the cotton manufacturing districts, where economy of fuel is based on coal consumption per pound of yarn spun, the comparisons made between one mill and another are liable to act as incentives to good firing. But the fireman who studies ends in or passes on to the engine room. I am sometimes inclined to think that we should burn less coal if promotion was from the engine room to the boiler house. The man in the engine room knows if he has steam supplied him in sufficient quantity, but cannot read the coal consumption in the pressure gauge. The man in the boiler house knows at once if there is anything amiss in the engine room, and it looks as though the boiler house should be the higher position, carrying most pay.

An Inexcusable Boiler Explosion.

A reader, Mr. William D. Troutner, who runs a machine shop in Pittsfield, Ill., sends us an account of a very disastrous and inexcusable explosion of the boiler of a portable engine, which occurred in that vicinity the evening of April 4th. The engine was a 12 horse-power traction, built by the Aultman Taylor Co., and was being used at the time by Samuel Oliphant and his son in running a saw-mill. For some unknown reason they had screwed the safety valve down until it was inoperative and had then raised the water two gauges, put in a fire, and left the engine to itself, while they were making some adjustments about the mill. The younger Mr. Oliphant then approached the engine, and as he did so an explosion took place which utterly demolished the engine, leaving no part of it upon the ground where it had stood, and throwing heavy pieces hundreds of yards. The younger Mr. Oliphant was instantly killed, and other men about the mill were injured. The boiler and engine were said to have been in a generally bad condition, having five top stay bolts gone; these being replaced with common half-inch stair bolts with washers and gaskets on them to make them steam tight.

At the inquest Samuel Oliphant stated that they had carried 150 to 160 pounds pressure all day, and how much more there was at the time of the explosion he did not know, as the safety valve was screwed down and the gauge was an old one that would register to 180 pounds. The verdict of the

coroner's jury was that the explosion was the result of an unsafe boiler with inexperienced men in charge of it.

Steamer "Priscilla."

The new passenger and freight steamer "Priscilla," for the Fall River Line, is nearing completion in the yards of W. & A. Fletcher Co., Hoboken, N. J., the builders of the engine and boilers. Both owners and builders are doing their utmost to make her the greatest success in point of fineness of lines, power, speed, capacity and elegance. Her trial trip will take place about the middle of May, and she will be ready for service in the beginning of June. The hull is built of steel, on the double hull, longitudinal, cellular system. Length on water line, 424 feet; length over all, 440 feet; breadth over guards, 93 feet; breadth of hull, 52 feet 6 inches; depth of hull molded, 21 feet 6 inches; draught of water loaded, 13 feet; displacement, 5,200 tons. Cargo capacity, 800 tons, carried on main deck forward of engine space; passenger and crew capacity, 1,600. There are 350 state-rooms for passengers, besides those for the president, captain, purser and other officers, as well as the usual quarters for waiters and other attachees of the boat. The engines are of the double inclined compound system, and will develop 8,500 horse-power when running at the rate of 25 revolutions per minute. There are two high-pressure cylinders 51 inches diameter, and two low pressure cylinders 95 inches diameter, stroke 11 feet. The air pumps are connected to the low-pressure cylinder. There are four independent centrifugal circulating pumps. The surface condenser contains 16,000 square feet of cooling surface. The wheels are feathering, are 35 feet diameter outside of buckets; length of buckets 14 feet, width 5 feet. The boilers, 10 in number, are of the single-ended Scotch type, mean diameter 14 feet; length, 14 feet 6 inches. There are 30 corrugated furnaces in all, inside diameter 44 inches. Total grate surface, 850 square feet; total heating surface, 24,000 square feet. The boilers are built for a working pressure of 150 pounds per square inch. The hull was built by the Delaware River Iron Ship Building and Engine Works, Chester, Pa. Joiner work by William Rowland, New York.

Meeting of Engineers.

It is announced that the fifth and last meeting (for the season) of mechanical engineers, for discussion of engineering subjects, will take place at the house of the A. S. M. E., Wednesday, May 9th, at 8 P. M. The subject will be "The Use of Water Tube Boilers in the Navy," and will be introduced by Passed Assistant Engineer, U. S. N., W. M. McFarland, of Washington.

Some Corrections.

Some typographical errors occurred in our description of the Watts Campbell engine, last week. We meant to say that the extra eccentric operating the exhaust valves of the low-pressure cylinders, provided for control of compression in these (the low-pressure) cylinders. Also that the division of the main bearings in the center of their length enabled the lower *shells* of the bearings to be removed endwise with half the clearance space that would otherwise be required. The types made us say other and senseless things, as may have been observed.

Our waste basket is a very capacious one, and on some days, when business is a little dull, we have some difficulty in filling it. On such days, therefore, we welcome the anonymous correspondent who signs himself only "Constant Reader," or something else other than his real name, and whose communication, therefore, helps to fill an otherwise unfilled void.

MANUFACTURES.

T. A. Hackworth, South Pittsburg, Tenn., will erect works for making hay presses.

An electric light plant will be put in at Meridian, Miss., by H. C. Floyd and E. Gallagher.

E. L. Cole, New Orleans, La., is erecting a plant to manufacture planer knives and cutters.

The Bristol (Pa.) and Trenton Trolley Company will erect an electric power house at Bristol.

The Wiscasset saw-mill plant, recently burned at Hattiesburg, Miss., will probably be rebuilt.

The erection of an electric light plant at Holly Springs, Miss., is contemplated by J. G. Leach.

At Franklin, N. H., the needle factory has started to run five and one-half days each week.

At Jacksonville, Fla., an electric power plant will be built. George W. Haines is superintendent.

A company is being organized at East Orrington, Me., to manufacture a newly invented hammer.

The Kansas City (Mo.) Steel and Iron Works will erect a plant, main building to be 16x150 feet in size.

The Belmont furnace, Wheeling, Va., blew in during the week after an idleness of several months.

Works will be built in Columbus, Ga., for the manufacture of breech loading shot-guns by Mr. Ostrander.

William E. Ginn, Baltimore, Md., has incorporated the Ginn Manufacturing Co. to manufacture a scissor sharpener.

The Metropolitan Sewage Commission, of Boston, will erect a large boiler and engine house in Charlestown, Mass.

In Michigan the International Electrical Supply and Manufacturing Company has formed in Detroit; capital, $500,000.

The National Sanitary Co., Washington, D. C., will manufacture steel carts and wagons. About thirty men will be employed.

The Duplex Car Co. is contemplating building in Pittsfield, Me., if satisfactory arrangements can be made with the town authorities.

At Attleboro, Mass., the Howard Bullough American Machine Co. has purchased a tract of land and will erect an $80,000 factory.

Better outlook warrants Paxton & Vierling, of Omaha, Neb., in spending $50,000 on a new foundry and on other improvements to their plant.

The work of making the tools for the new magazine rifles at Springfield, Mass., is finished, and the manufacture of the guns is well under way.

M. J. Cowles and Frank E. Kellogg have incorporated the Cowles-Dennison Manufacturing Co., St. Louis, Mo., with a capital stock of $6,000.

The Reliable Edge Tool Company, of Indianapolis, reports business improving. The company is preparing to build new works on a more extensive scale.

Heber Wells, manufacturer of printers' materials, pattern and brand letters, has removed from 8 Spruce street, New York, to 157-159 William street, New York.

The E W. Blumer Manufacturing Co., St. Louis, Mo., has been organized with a capital stock of $15,000. Esaias W. Blumer and Robert Fullerton are the incorporators.

The Hill & Whitney Manufacturing Co. has been organized at Berwick, Me., for the purpose of making machinery implements. The officers are: President, Fred H. Hill; treasurer, C. F. Whitney.

The Kansas City (Mo.) Steel and Iron Works was recently organized with a capital stock of $350,000, of which one half has been paid in. The company will manufacture steel, iron, brass and copper.

At Cooper, W. Va., a charter has been granted to the Bluestone Electric Light Co. with a capital stock of $50,000. The incorporators are John Cooper, B. Moore and Isaac Mann. They will erect a plant.

We have received the catalogue of the Pawtucket Mfg. Co., Pawtucket, R. I., illustrating special machinery for the manufacture of bolts and nuts upon a large scale. The catalogue illustrates complete plants for this purpose, and is a valuable one to all interested in this line of work.

The Ober Handle Co., of Chagrin Falls, O., which cut the wages of its employes 25 per cent. last November, has gone back to the old scale. The

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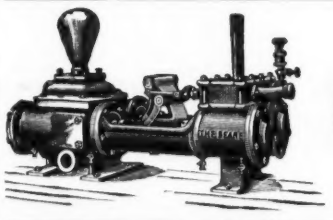

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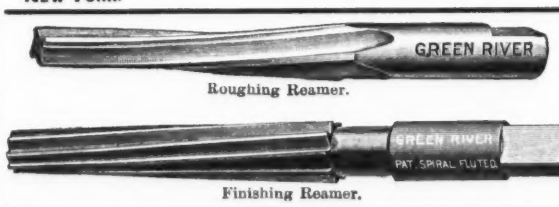

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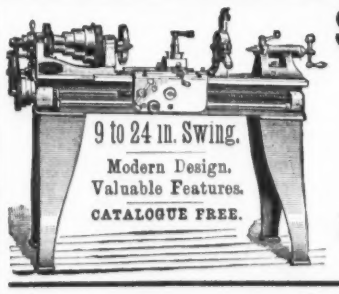

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works are running full time and the employes are jubilant.

The Morris Machine Works, of Baldwinville, N. Y., report that their business of making centrifugal pumping machinery has greatly increased during this year, and at present they are working day and night to fill orders.

The Indianapolis Stove Company is now working full time with 100 men at work, about two-thirds its usual force. President Bennett states that there is no rush of orders, but enough come in to keep matters moving at the present pace.

J. F. Rogers & Co., of New York City, have placed the order for a new industrial school building at Havana, Cuba, with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 15 meters wide and 48 meters long, constructed entirely of iron and cement.

The J. W. Chamberlain Co. has been formed at Bangor, Me., for the purpose of manufacturing plumbing, steam and hot water apparatus and appliances, with $10,000 capital stock. The officers are: President, Joseph W. Chamberlain; treasurer, James E. Chamberlain.

The Overman Wheel Company, Chicopee, Mass., are unable to fill all orders now, although working 1,000 men until 10 o'clock at night, and they may decide to run day and night next week. The company have a large demand for their wheels this year, and are running behind on their orders.

A grindstone recently burst in the American Edge Tool Company's upper shop in Oakland, Me. A portion of the stone weighing nearly a ton was thrown with great violence through the side of the building, and fell fully 70 feet away. A man was working on the stone at the time it burst, but escaped uninjured.

Notices have been posted at the gates of the Marshall Thread Mills, Newark, N. J., stating that the 10 per cent. reduction made in the wages of the employes about a month ago is to be restored at once. At the time of the reduction all of the departments in the mill were affected. The mills are now running on full time.

The Hardy Machine Co., Biddeford, Me., have elected officers for the ensuing year as follows: Directors, Rishworth Jordan, Luther Bryant, Charles E. Goodwin, John H. Burnham, Jesse Gould, Fred A. Tarbox, Frederick A. Day; president, Rishworth Jordan; treasurer, Fred A. Tarbox; secretary and auditor, Jesse Gould.

The Rue Mfg. Co., 116 North Ninth street, Philadelphia, Pa., have issued a catalogue illustrating and describing the "Little Giant" Injector in its latest improved form. Besides full illustrations of the injector itself, it is shown as applied to various purposes, and there is much information in the catalogue of interest to users of injectors.

The Indiana Tumbler and Goblet Co., of Greentown, Ind., are erecting an extensive glass factory for the manufacture of fine table ware. They have just contracted with the Lodge & Davis Machine Tool Co., of Cincinnati, O., U. S. A., for a complete outfit of machine tools, including lathes, shapers, drill presses, etc., to be used in their repair shops.

The "W. & S." Hydraulic Machinery Works, 204-210 East Forty third street, New York, have issued a special catalogue and price list which refers to improved hydraulic jacks. These are shown in perspective and section, and full information is given regarding all the various forms. Screw jacks of various kinds are also illustrated and described.

The town council of Lorain, O., has accepted the proposition submitted to it by the Johnson Company, of Johnstown, Pa., regarding the location of a steel plant at that place. Engineers are now making surveys of the ground, and the council has pledged itself to make a suitable channel, so that vessels can carry material to be used in the erection of the plant.

The National Lead Co., of No. 1 Broadway, New York, have issued a small pamphlet entitled, "Anti-friction or Babbitt Metals." While it is, of course, intended primarily as an advertisement of the anti-friction metals made by this company, yet it contains a good deal of matter which is instructive for mechanics, and the pamphlet is well worth having. It is sent upon application.

The American Tin Plate Machine and Manufacturing Co., of Linfield, Pa., has its plant in full operation, making about 10 tons a day of finished plates. The company has closed a contract for the entire output of the plant for some time to come. The improved automatic continuous machinery at present in use is being duplicated, and the output will, therefore, be doubled.

A Raleigh (N. C.) dispatch says: A new cotton-mill, to be built by neighboring farmers, who are to take stock to the amount of $100,000, is to be erected in the country on Coddle Creek, in Cabarrus County, N. C. The location is near Concord, where there are a number of cotton-mills. There is said to be fine water power on Coddle Creek, by which the new mill will be run.

Latest news is that the Howard Bullough American Machine Co. is to erect an $80,000 plant, in Attleboro, Mass. The concern was offered 25 acres of land and taxes ten years, which is equal to $60,000, but this has not been accepted. At present the company has a large number of mechanics and draftsmen at work in Pawtucket, manufacturing tools and patterns for the new firm.

We have received from the Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Pa., a catalogue which fully illustrates and describes the Cochrane feed-water heaters and purifiers and special heaters, some of which have been illustrated in our columns. The catalogue contains a great deal of information which will prove useful to those in charge of, or interested in steam plants, to whom it is sent on application.

The Vulcanized Fiber Co., of Wilmington, Del., have issued a catalogue and price list which gives full information in regard to the wide variety of mechanical articles which are made by this company from what is called vulcanized fiber, flexible fiber and graphoid fiber. These materials are used for washers, thrust bearings, journal bearings, slides, engine gibs, and for a great many other similar purposes. The catalogue is sent upon application.

The new electric light and power station for the Brush Electric Light Co., at Baltimore, Md., will be one of the finest in the Southern States. The boiler room is 83 feet wide by 129 feet long. The dynamo room is 130 feet square, the floor space in the latter is entirely free from posts. The roofs are designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn., and are built entirely of iron, covered with their patent anti condensation corrugated iron roof covering.

We have received from Patterson, Gottfried & Hunter, Limited, 146-150 Centre street, New York, "Price List No. 3 of the American Brass Manufacturers." This gives prices of everything usually made by brass manufacturers, including roll and sheet brass, platers' metal, slitting metal, sawed metal, scrap, jewelers' or gold metal, high brass rods, wire in coils, etc. It also contains a table showing the difference between what is called the "London," the Stubs' and the Brown & Sharpe wire gauges, a table giving the weight of copper and brass wire, one giving the weight of brass plates, and one showing the weight in pounds of sheet and bar brass.

The *Tradesman*, of Chattanooga, Tenn., in its weekly review of the industrial situation in the South for the week ending April 23d says: The strike among the coal miners in the Birmingham and Jellico districts of Alabama and Tennessee has unsettled business for the time being. It has not proved to be as general as was predicted, but several thousand men have gone out of the mines. Impartial observers believe that the strike will be a short one, partly because the demands of the strikers are considered to be extreme, and also because there is a lack of funds with which to support them while out of work. In addition to the reduction in freight rates on iron pipe to Northern points recently announced, a reduction of a similar kind has been made to Southern and Southwestern points, to take effect May 1st. It is unfortunate that these reductions are counterbalanced by labor troubles. As it is claimed that fuel supplies are sufficient for a month to come, it is hoped that an adjustment will be made before that time expires. In other industrial lines reports are encouraging. The effects of the cold wave have not proved as disastrous as was anticipated.

Special Agent Ira Ayer reports to the Treasury Department that during the quarter ended December 31, 1893, thirty-nine firms manufactured 27,351,241 pounds of tin and terne plates proper, against an output of 27,145,480 pounds by thirty-five firms during the previous quarter. Of the output 15,907,669 pounds, or more than 58 per cent., were

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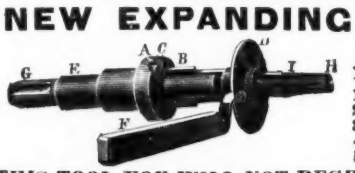

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No.			Price.
1	⅛ to 1	in.	$10
2	1 "	1½ "	14
3	1½ "	2 "	18
4 (with screws)	2 "	3 "	32
5 " "	3 "	4 "	44

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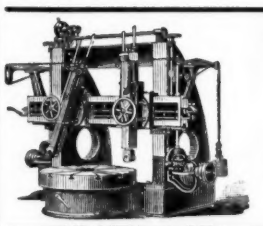

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2 36 in. x 11 ft. Horizontal Stationary Boilers.
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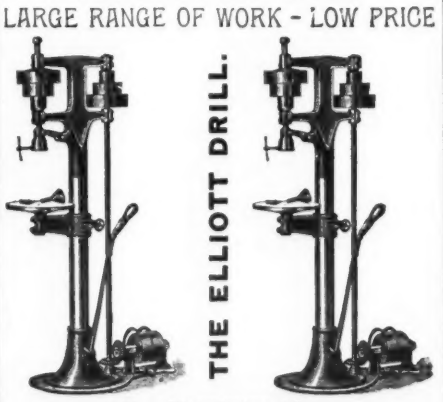

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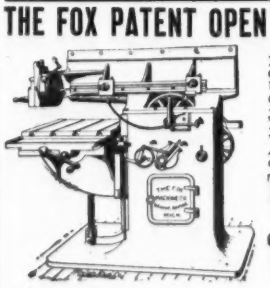

No springing of ram. No overhanging table. Quick Return. Stroke Under Perfect Control. Can be Instantly Adjusted 1 16 in. or 24 in. No Screws to Monkey with. Powerful, Quick, Accurate. Write for circular.
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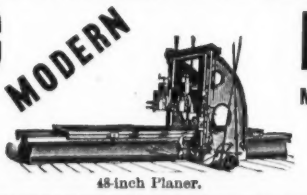
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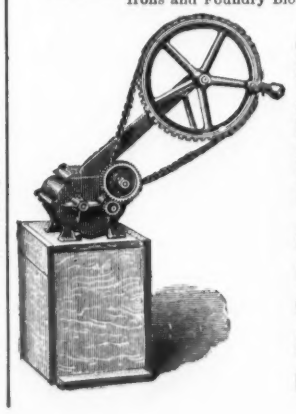

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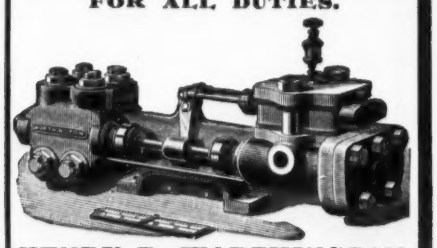


HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO,
ST. LOUIS, DENVER.

made from sheets rolled in the United States, and of this amount 15,309,009 pounds, or more than 96 per cent., consisted of the class of plates weighing less than 63 pounds to the 100 square feet. The quantity of American sheet-iron and steel made into articles and wares terned or tin-plated was 1,244,707 pounds. This makes the aggregate output of tin and terne plate for the quarter 28,593,948 pounds, against 28,198,293 pounds for the previous quarter. Three new companies made their first sworn returns. The production of black plates in the United States was 19,679,910 pounds. Of the thirty-nine firms, twenty-one used wholly American plates, twelve both American and foreign plates, and six used only foreign plates.

Machinists' Supplies and Iron.

New York, April 28, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.50 to $13.25; No. 2, $11.50 to $12.25; Gray Forge, $10.75 to $11.00. Southern brands are quoted at $12 00 to $12.50 for No. 1 Foundry; $11.00 to $11.50 for No. 2, and $10.50 to $11.00 for No. 3.

Antimony—The market is dull and quiet. We quote L. X., 9¼c. to 9⅜c.; Cookson's, 10c. to 10½c.; Hallett's, 8.65c. to 8.75c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 63c. to 65c.

Copper—The market is dull. The nominal quotation for Lake Copper is 9½c. The demand is light. Casting Copper is held at 9¼c. to 9¼c.

Lead—The market is quiet and the demand indifferent. The general quotation is 3.45c. for prompt delivery, but it is believed that 3 40c. would buy. Some business for summer delivery has been done at the latter figure.

Spelter—The market is firmer. Holders have advanced their New York delivery price to 3.60c. and 3.70c. The firmer views of sellers are said to be due to a sale of 550 tons for delivery West at a price equivalent to 3.55c here.

Tin—The market is sensitive and tending upwards. Sales have been made at 19.85c., the asking is 19.90c. The change to higher prices is due to the London market.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Situation, stamp'g w'ks. Sup't, Am. Ma.

A prac. mech., 8 yrs. foreman, wants pos.; age 34, habits A 1. Foreman, American Machinist.

Situation wanted by first-class patternmaker. Address La. B., American Machinist.

A mechanical draftsman desires engagement. Address Staff, American Machinist.

Mech. drafts'n, 3 yrs. exp., has tech. education, desires position after June 1st. Box 70, Am. Mach.

Patternmaker wishes pos.; good capable workman with best of refs. W. C. S., Am. Machinist.

Toolmaker, machinist, 34, experienced on hard ening fine tools, care of tool-room and shop mach'y, wants position. Box 68, American Machinist.

Young draftsman, graduate of college in Sweden, desires position; salary a secondary consideration Address Box 69, American Machinist.

Blacksmith wants a position; tool-work a specialty; will pay for all tools spoiled in hardening. Address Box 71, American Machinist.

A mech. engineer, thorough machinist, good designer and draftsman, desires situation with growing concern; will invest $500. Advance, Am. Mach.

A practical mechanic with extensive exp. as foreman (machine tools and manufacturing), desires position; A1 reference. W., Am. Machinist,

A skilful mechanical engineer, A1 draftsman and designer, familiar with structural work and all kinds of mach'y, desires pos. Box 73, Am. Mach.

Wanted—Position by a machinist and toolmaker who is capable of taking charge of works. Address "Energy," American Machinist.

Wanted—Place as superintendent or foreman by first-class toolmaker and machinist used to close interchangeable work; can work men to advantage. Address Box 74, American Machinist.

Draftsman and vise hand; graduate of a technical school in Germany; have some experience in designing; wishes position in drawing-room or shop. Address H. F., 15, American Machinist.

Any manufacturer of machinery requiring a young mechanical engineer as salesman, possessing push, enterprise and good address, will find a remedy for dull times by addressing Phila., care Amer Mach.

Permanent position wanted by first-class machinist and toolsmith; all-around man; 19 years' experience; job as repairer in factory preferred. Address K. B., American Machinist.

Advertiser wishes to communicate with responsible firm to manufacture new type gas engine; simple, economical and higher efficiency than any other. Address Gas Engine, Amer. Machinist.

Wanted—Position as foreman in iron foundry, one familiar with all kinds of light and heavy castings in green, dry sand, and loam; references from last employer. P. H. Fox, Am. Machinist.

A first-class man having 12 years' experience in the manufacture of steam engines on a large scale on the interchangeable plan and jig system, desires a position as superintendent. Address C. D., American Machinist.

Business opening—A superintendent wanted for a long established company building Corliss engines and heavy machinery specialties, a man having $10.000 to $25,000 to invest in the business and to take charge of the manufacturing department; only men well up in best methods of low cost work in machine shop and foundry and having record with successful companies will be considered. Address "Corliss," care Am. Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York,Clev'd,O

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses,engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O

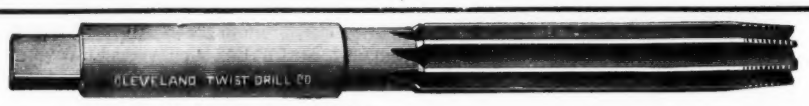
Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Calipers, Surface Gauges, etc. Catalogue free. Send for it. F. A. Welles, Milwaukee, Wis.

Proposals wanted for the immediate construct'n of a 15-ton geared locomotive. Engineer, Am. Mach.

For Sale—Successful and paying machine shop and foundry. Good reasons for selling. Address Box 72, American Machinist.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.



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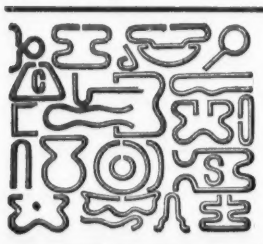

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With F. B. Manville's Patent Sliding Former,

For making articles from the coil, of either round, half round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.

Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.

Bicycle and Labor Saving Machinery a Specialty.

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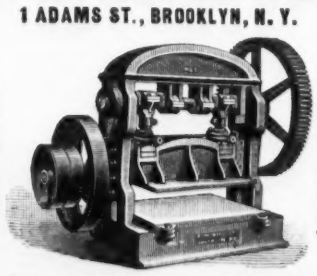

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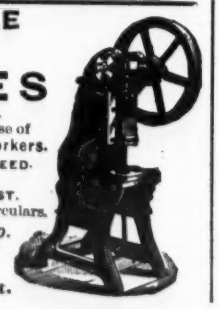

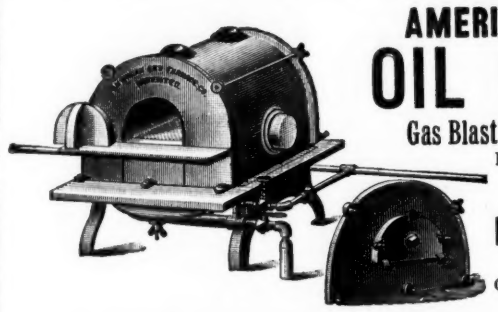

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Gas Blast Furnaces & High Pressure Blowers

For the economical generation and systematic application of HEAT.

CATALOGUES ON APPLICATION.

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Second-Hand Machinery.

We offer at very attractive prices, a lot of machinery from

THE NEW HOWE SEWING MACHINE CO.'S PLANT.

INCLUDING,

Engine Lathes,
Milling Machines,
Hand Lathes.
Planer, Drill Press,
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Also a large stock of

SECOND-HAND MACHINE TOOLS

of all kind, in excellent condition. Write for complete list, descriptions and prices.

GARVIN MACHINE CO.,

LAIGHT and CANAL STS., NEW YORK.

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NEW AND SECOND-HAND.

Shear No. 27, 30 in. throat, ¾ in. plate.
Above entirely New, made by Bement, Miles & Co.
Boiler Rolls, 8 ft. 3 in and 10 ft. between Housing.
Boiler Punch, 21 in., 30 in. and 38 in. throat.
57 in. Swing Driving Wheel Lathe, Double Head.
98 in. Hydraulic Rivetter. A1.
15 Ton Hydraulic Crane. A1.

ENGINE LATHES.

72 inches x 28 feet.
54 " 18 "
48 " 16 "
40 " 14 "
25 " 24 and 16 feet.
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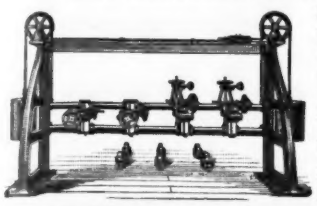

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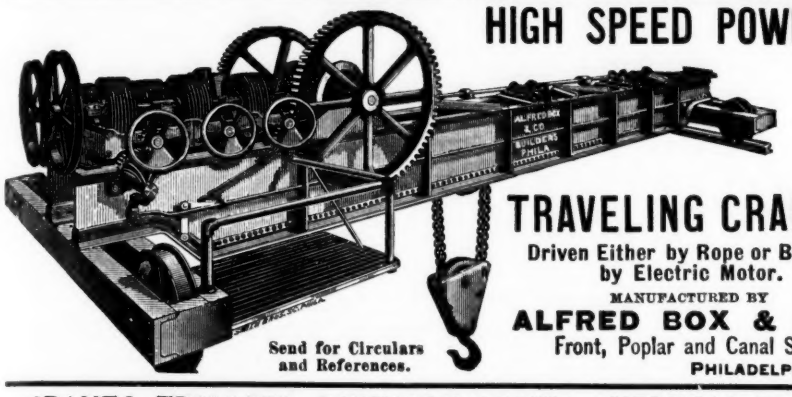

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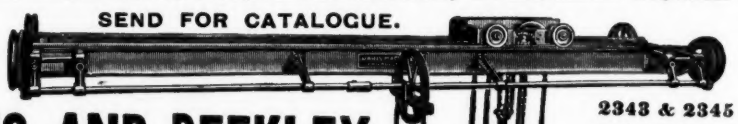

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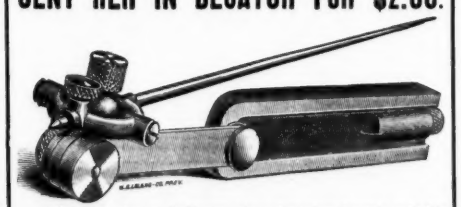

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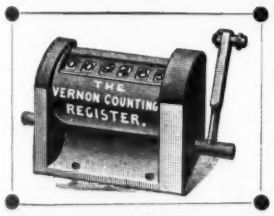

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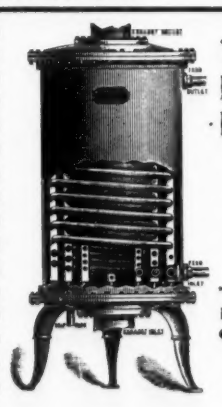

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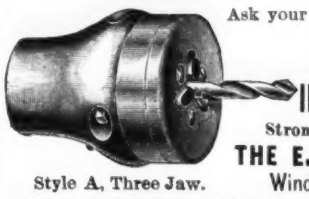

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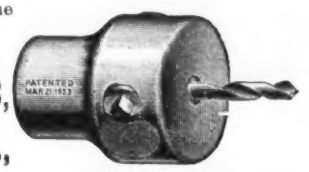

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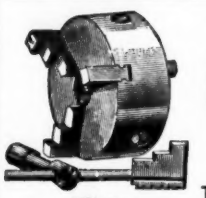
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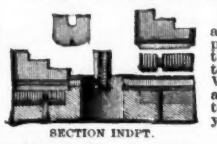
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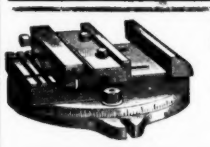

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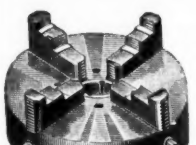

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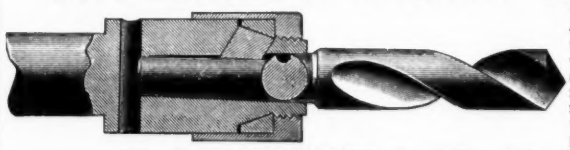

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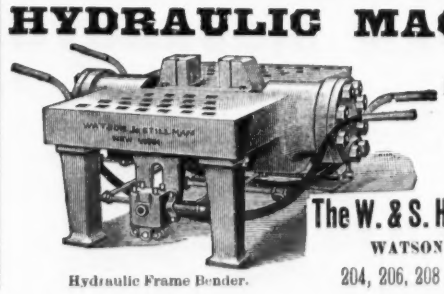
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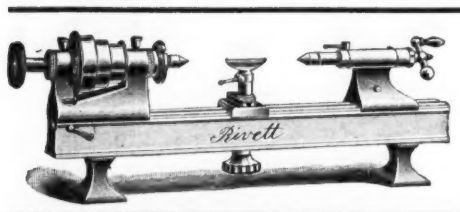

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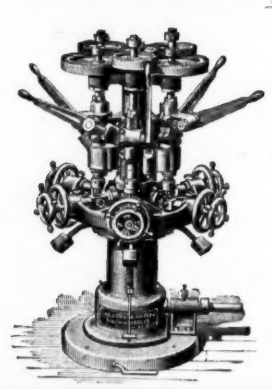

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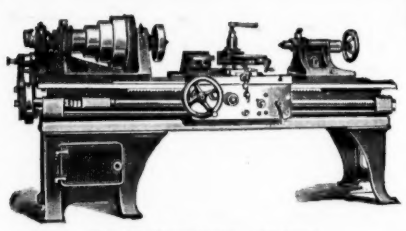

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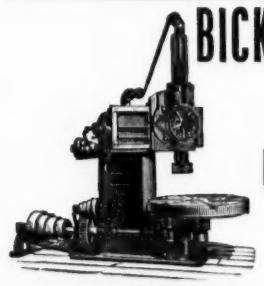

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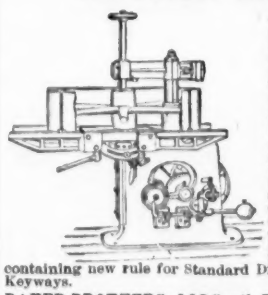

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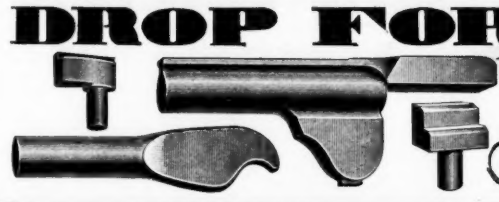

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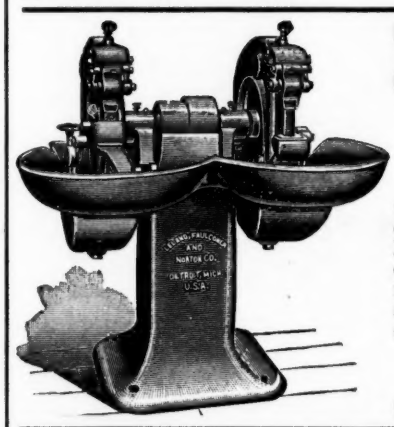

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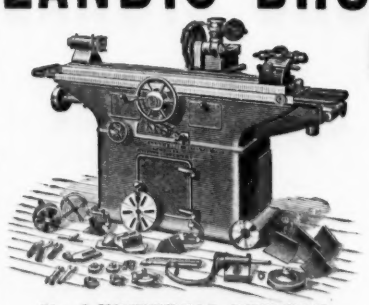

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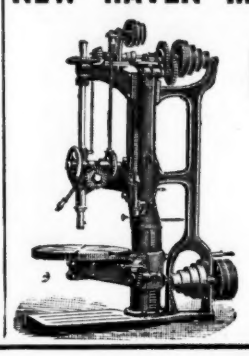

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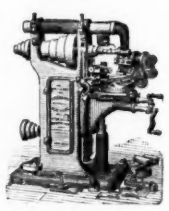

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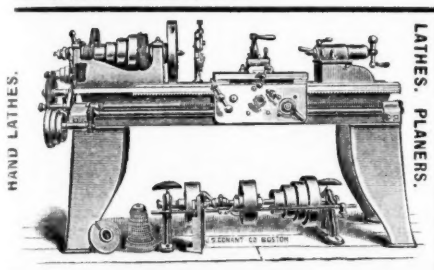

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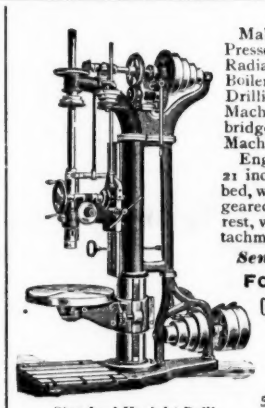

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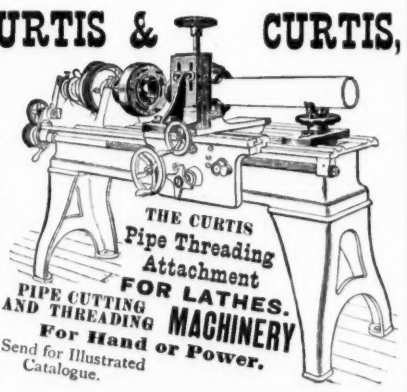

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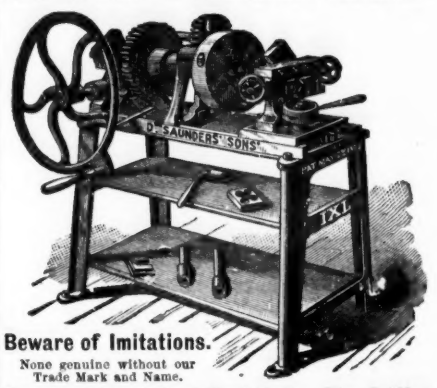

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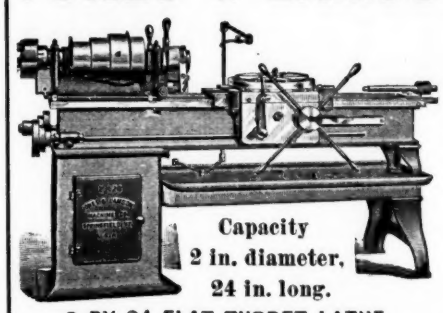

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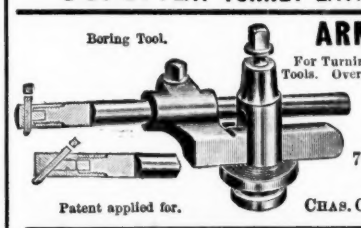

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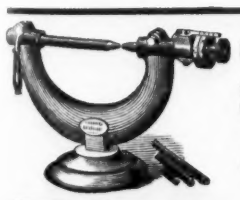

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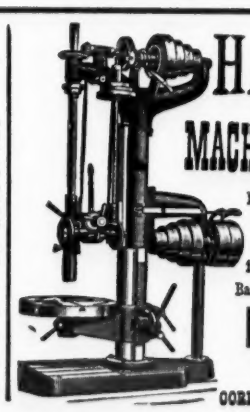

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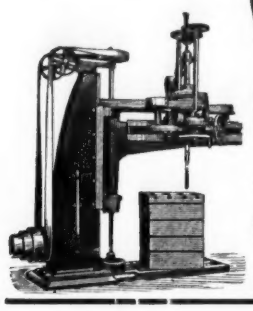

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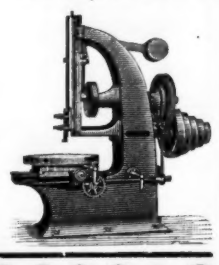

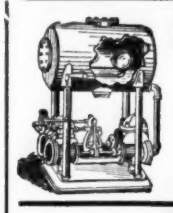

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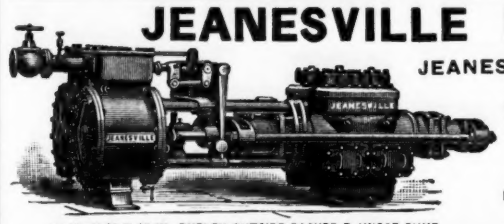

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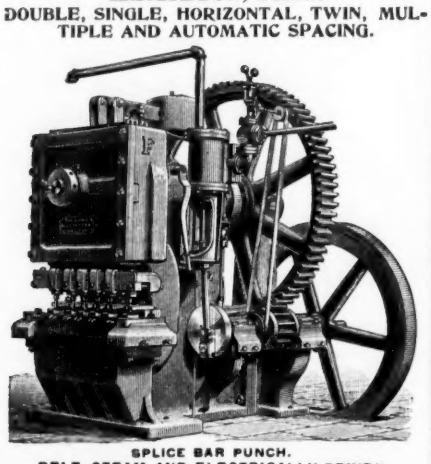

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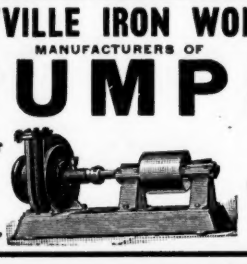

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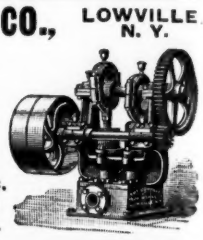

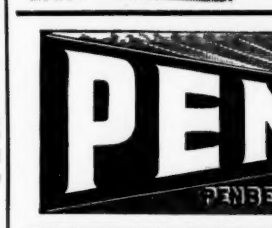

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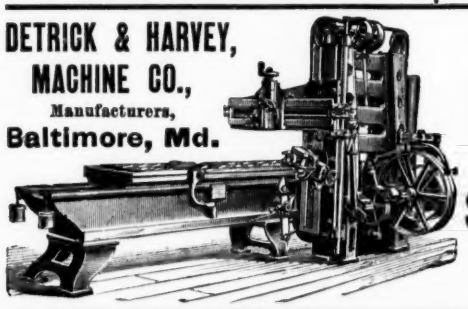

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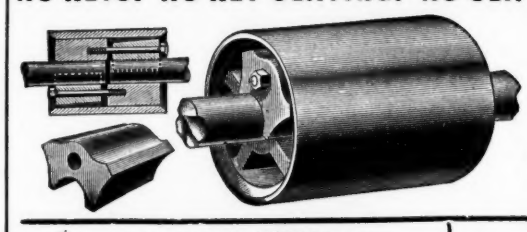

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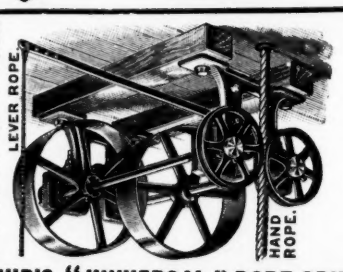

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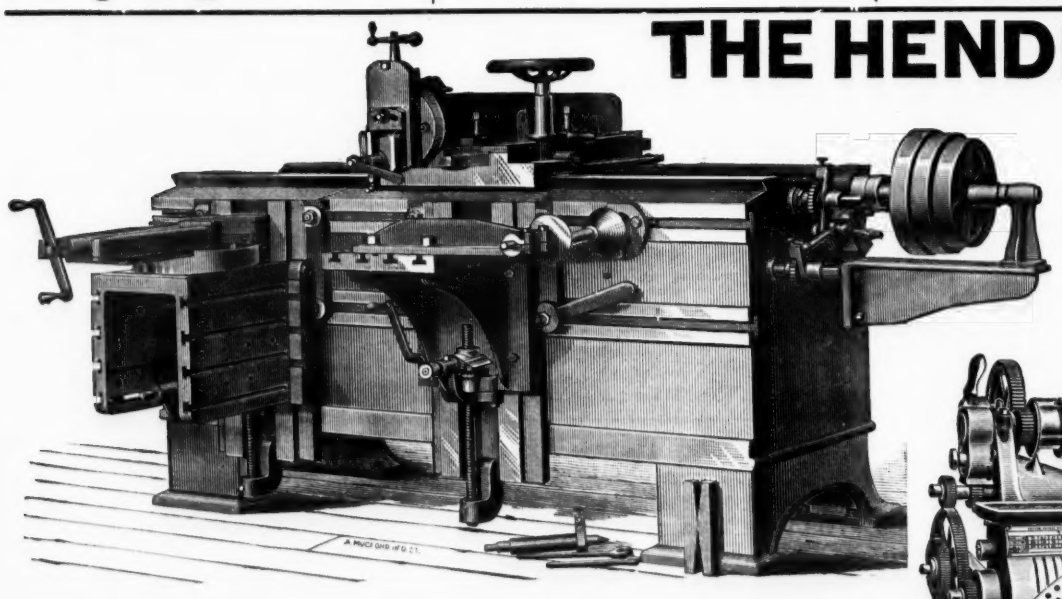

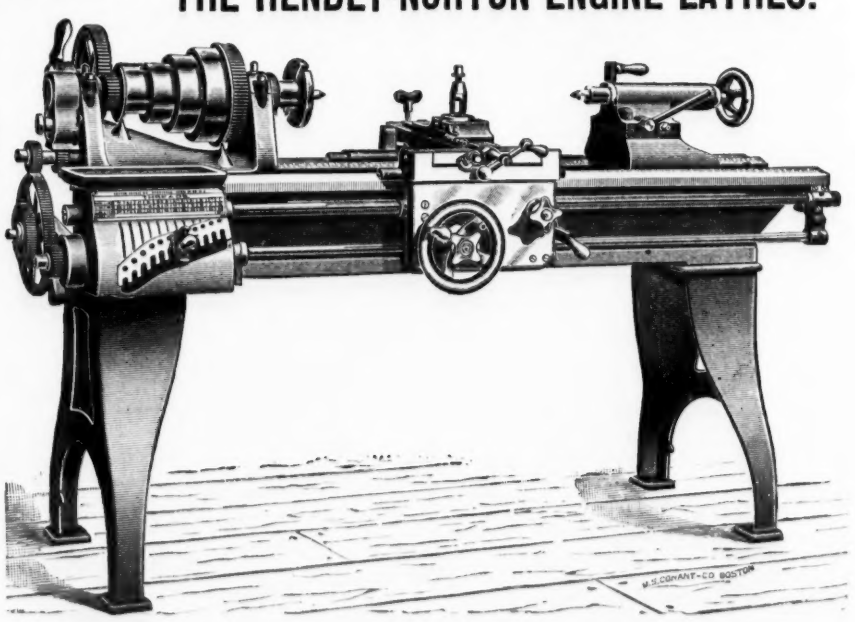

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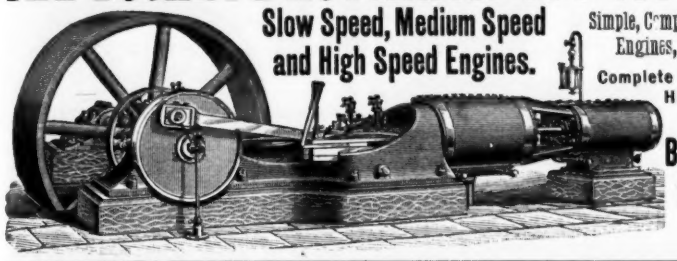

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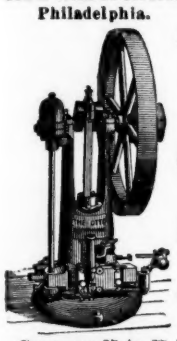

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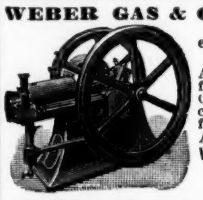

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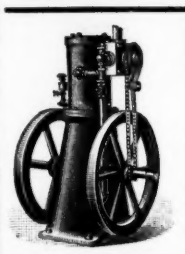

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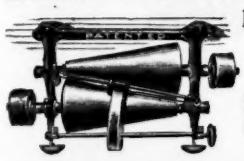

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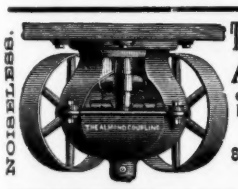

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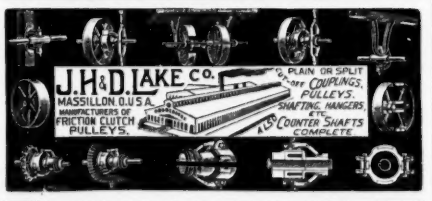

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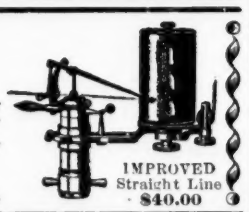

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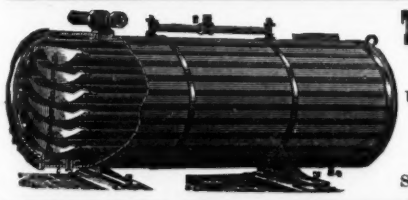

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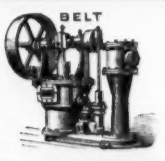

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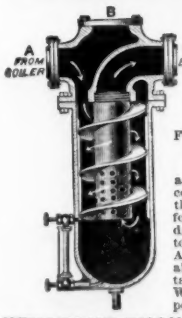

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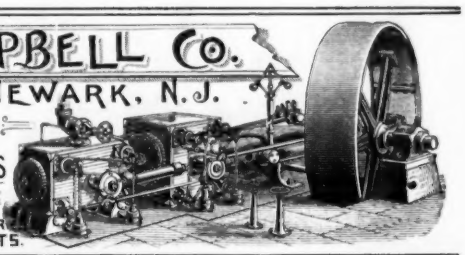

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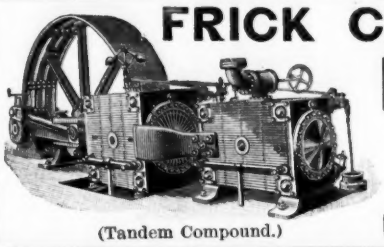

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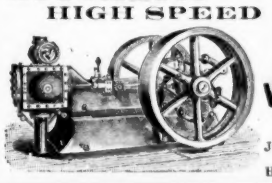

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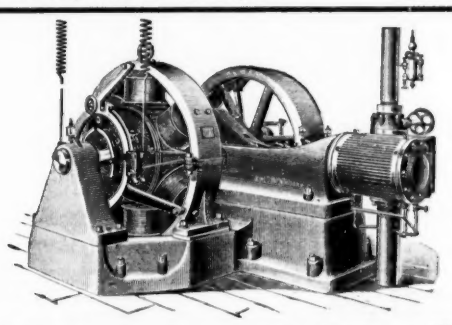

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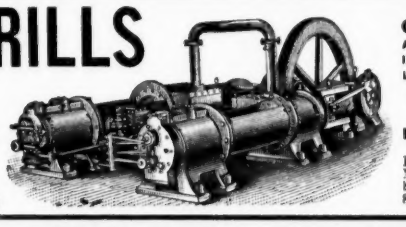

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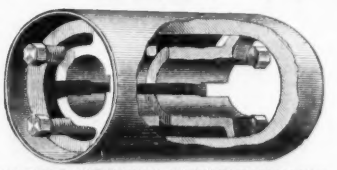

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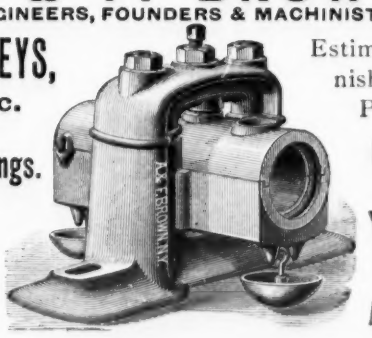

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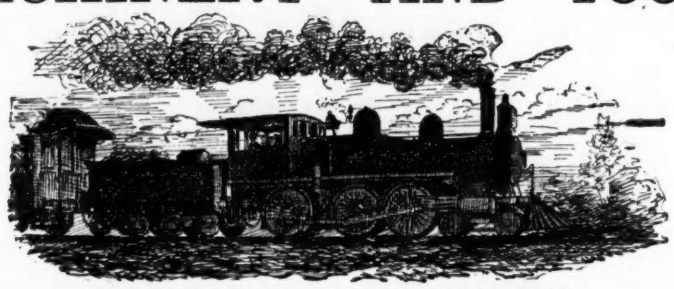

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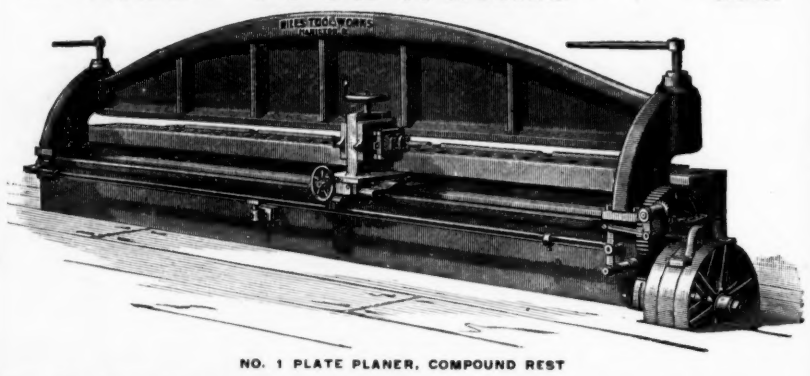

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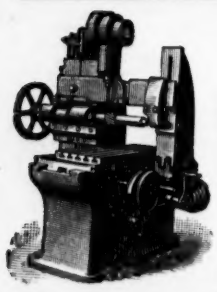

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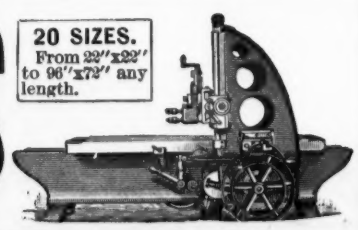

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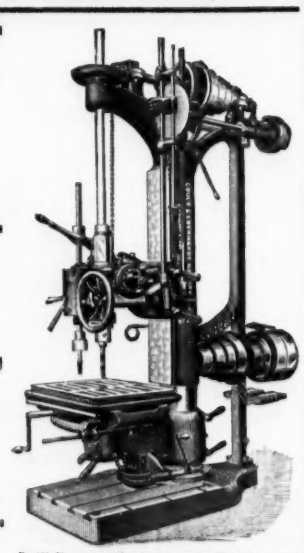

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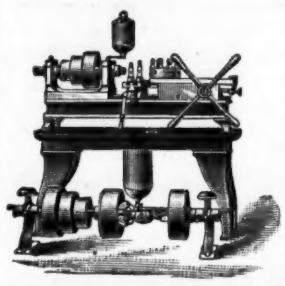

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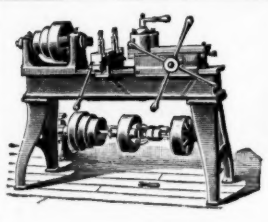

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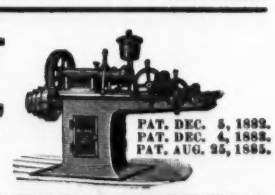

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